United States Department of Agriculture

Final Environmental Impact Statement for the Flagstaff Watershed Protection Project

Coconino National Forest
Coconino County, Arizona

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Coconino National Forest
Coconino County, Arizona

Lead Agency: USDA Forest Service

Cooperating Agencies: City of Flagstaff

Arizona Game and Fish Department

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Abstract: This environmental impact statement discusses the effects associated with four alternatives, including the No Action Alternative, the Proposed Action with Cable Logging, the Proposed Action without Cable Logging, and the Minimal Treatment Alternative. No alternative is preferred, and the final decision could contain a melding of two or more alternatives. All three action alternatives would require two Forest Plan amendments: one to allow treatments within Mexican spotted owl habitat to be more in line with the revised Mexican Spotted Owl Recovery Plan (USFWS 2012) and one to allow mechanical treatment on slopes above 40 percent (see Chapter 2 and Appendix A).

In order to have standing to object to the draft decision, reviewers must provide the Forest Service with their comments during the review period of the draft environmental impact statement or other designated comment period (e.g. scoping). This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the final environmental impact statement, thus avoiding undue delay in the decision making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewers' position and contentions. Environmental objections that could have been raised at the draft stage may be waived if not raised until after completion of the final environmental impact statement. In addition, 36 CFR 218.8(c) states "issues raised in objections must be based on previously submitted specific written comments regarding the proposed project or activity and attributed to the objector…". Comments on the draft environmental impact statement should be specific and should address the adequacy of the statement and the merits of the alternatives discussed (40 CFR 1503.3).

Send Comments to: Erin Phelps
5075 N. Hwy 89, Flagstaff, AZ 86004

Summary

During the November 2012 elections, residents of Flagstaff, AZ approved a $10 million bond to support fuels reduction work within key watersheds primarily located on the Coconino National Forest and also within City lands, private parcels and State of Arizona lands. Identified on the ballot as the "Forest Health and Water Supply Protection Project," the planning effort on the National Forest segment is now known as the "Flagstaff Watershed Protection Project (FWPP)." This is one of only a handful of examples in the country where fuels reduction work on the National Forests is being funded by a municipality, and the only known instance where such an effort is funded from municipal bonds.

There have been notable successes with forest thinning efforts, both within and adjacent to the City in the past decade, where emerging wildfires entered treated areas and were able to be effectively and safely suppressed with minimal damage. However the experience of the Schultz Fire in 2010 demonstrated the potential for severe downstream impacts even when residential areas are spared from the fire itself. Following the Schultz Fire, severe and repeated flooding occurred in unincorporated neighborhoods just outside Flagstaff city limits, causing tens of millions of dollars of damage to infrastructure and private property.

Predictions of post-fire flooding suggest that a wildfire in the Dry Lake Hills could cause widespread flooding in such areas as downtown Flagstaff and that post-fire erosion could impact the City of Flagstaff's ability to utilize Upper Lake Mary as a domestic water supply.

The FWPP analysis area includes approximately 10,544 acres (roughly 7,569 acres in the Dry Lake Hills portion and 2,975 on Mormon Mountain) and includes portions of the Coconino National Forest that have either not been analyzed or not been treated previously due to prohibitive costs associated with very steep terrain, low value material, and other challenging issues such as potential impacts to wildlife and visual concerns.

The primary purpose of FWPP is to reduce the potential for a high severity wildfire and subsequent flooding in two key watersheds near Flagstaff, Arizona: the Dry Lake Hills portion of the Rio de Flag Watershed (DLH) and the Mormon Mountain portion of the Walnut Creek-Upper Lake Mary Watershed (MM) (see Chapter 1 for more information). More specifically, there is a need to reduce the potential for crown fires, high intensity surface fires, and to reduce the likelihood of human-caused ignitions. Subsequently, FWPP is a fire risk reduction project with components of restoration; Chapter 2 contains more information on the differences and similarities between the two. Risk in the context of this analysis refers to the potential occurrence of a high severity fire; fire hazard may also be used per Hardy et al.'s definition: "Fire hazard expresses the potential fire behavior for a fuel type, regardless of the fuel type's weather-influenced fuel moisture content" (2005).

The Forest Service published a proposed action in April 2013 to engage the public and solicit feedback. During the scoping process, the public raised concerns about certain aspects of the proposed action, including the use of cable logging, potential impacts to the threatened Mexican spotted owl and its habitat, and the removal of large and old trees (see Public Involvement section in Chapter 1 for more details).

These concerns led the agency to refine the proposed action and develop two additional alternatives including one that would avoid the use of cable logging, and another that would treat the "minimal" amount necessary to still meet the purpose and need.

The EIS analyzed a variety of harvesting and fuel reduction methods to meet that purpose, including the use of traditional ground-based equipment, hand thinning, and also methods

atypical for the region, including cable and helicopter logging, in order to treat steep, inaccessible terrain. Alternatives 2 and 3 are similar in that the treatment objectives and acreages are roughly the same; the differences between the two alternatives lie in the implementation methods. Alternative 2 would utilize cable logging to remove timber, while Alternative 3 would instead use a combination of specialized steep-slope machinery and helicopters. Alternative 4 would treat less acreage and use a “minimal treatment” approach, where the steepest slopes would largely remain untreated and efforts would be focused on the lower and upper portions of the hills, where traditional ground-based equipment could be utilized, along with hand felling in the rougher terrain. Chapter 2 contains more information about the alternatives and their associated design features.

Major conclusions include:

Alternatives 2 and 3 would have the greatest reduction in active crown fire potential: from approximately 57 percent of the project area under the No Action Alternative to 7 percent under Alternatives 2 and 3, compared to approximately 28 percent under Alternative 4. Alternatives 2 and 3 would also result in the greatest reduction in post-fire predicted peak discharge associated with a 100-year storm event (1 percent recurrence interval): 60 percent reduction for Alternatives 2 and 3 versus 30 percent reduction for Alternative 4 as compared to the No Action Alternative. All three action alternatives include a Forest Plan amendment to allow mechanized equipment for thinning on slopes greater than 40 percent (see Forest Plan Amendments in Chapter 2 and Appendix A for more information).

Due to the cable logging corridors and the safety requirements of both cable logging and helicopter logging, Alternatives 2 and 3 would remove the greatest number of snags, resulting in greater impacts to Mexican spotted owl (MSO) critical habitat. All three action alternatives would include a Forest Plan amendment related to treatments in MSO habitat which include thinning and prescribed burning in the Schultz Creek nest core, prescribed burning only in the other nest cores, mechanized thinning up to 18 inches dbh in PACs, and a project-specific monitoring proposal. Per the amendment, treatments with MSO protected activity centers (PACs) would also be allowed for up to two breeding seasons, which would result in impacts to MSO. A Monitoring Plan for MSO has been developed in coordination with the US Fish and Wildlife Service to monitor effects to MSO and their habitat components (see Chapter 2 and Appendix B for more information). Project activities are not anticipated to change trends for any Management Indicator Species (MIS), or Forest Service Sensitive Species. The Wildlife section of Chapter 3 contains more detailed analysis of the impacts on wildlife.

Under all three action alternatives, old growth and large trees in both ponderosa pine and mixed conifer vegetation types would be retained per the design features listed in Chapter 2. At a project level, there is little difference between action alternatives in the number of trees greater than 18 inches dbh post-treatment, with trees greater than 24 inches dbh likely to be removed only under Alternative 2 for cable logging corridors. On Mormon Mountain, there is no difference shown in modeling as the wet mixed conifer band that is deferred in Alternative 4 would still receive only light treatment in the other two action alternatives (creating regeneration pockets within aspen stands, piling and burning of dead and down material). In the Dry Lake Hills, there is a slight difference in the ponderosa pine treatments, where an average of four trees per acre greater than 18 inches dbh would be cut in Alternatives 2 and 3, and an average of three trees per acres greater than 18 inches dbh would be cut under Alternative 4. Trees greater than 24 inches dbh would not be targeted for removal under any alternative, and in fact, the only place that the modeling shows them being removed is in the cable corridors under Alternative 2. The Forest Structure and Health section contains numerous tables and discussion on post-treatment conditions for all the alternatives, and also models those conditions out 20 and 40 years after treatment. The Wildlife section of Chapter 3 contains more information about removal of larger trees and snags within

MSO habitats under the action alternatives. Chapter 2 contains a Comparison of Alternatives table that summarizes some of the key differences between the alternatives.

Based upon the effects of the alternatives, the responsible official will decide the best method for treating within the project area, which could involve a blending of alternatives. This “blending” could mean that a portion of two or more alternatives are chosen to essentially create a new alternative, as long as that decision includes actions that are identified and the potential effects are disclosed through the analysis of at least one of the alternatives. The range of alternatives included in the EIS seeks to cover every feasible treatment option so that the responsible official can compare effects of each before deciding. This way, the decision could include components of each alternative; for example, cable logging in certain portions of the project area, helicopter logging in more sensitive habit, and no treatment in others.

This FEIS includes a number of changes based on comments and meetings held during the comment period on the DEIS. The main changes between the draft and final EISs include:

- Inclusion of a Socio-Economics section to address public comments related to project impacts on local economies and communities.
- Change in location of the temporary road proposed south of Mount Elden and north of the private property boundary.
- More detailed information in the Scenery section about cable logging examples both in the southwest and in other areas with similar ecosystems, such as eastern Montana.
- Development of a separate document (the Implementation Plan) to discuss the implementation process, including timber sale/stewardship preparation activities, Forest Service oversight of contractors, sequencing of treatments and timeframes, and coordination with recreation and special use permit activities.

More information about the changes between the draft and final EIS are discussed in Chapter 1.

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Commonly Used Acronyms

AZGFD – Arizona Game and Fish Department

BA – Basal area

BMP – Best management practice

CNF – Coconino National Forest

CTL – Cut to length

CWPP – Community wildfire protection plan

Dbh – Diameter at breast height

HUC – Hydrologic unit code

ERI – Ecological Restoration Institute

FR – Forest road

FSVeg – Field sampled vegetation

4FRI – Four Forests Restoration Initiative

FRCC – Fire regime condition class

FWPP – Flagstaff Watershed Protection Project

IDT – Interdisciplinary Team

LOPFA – Landscapes outside of northern goshawk post-fledging family areas and Mexican spotted owl protected activity centers

MA – Management area

MEDL – Mount Elden – Dry Lake Hills Recreation Planning Project

MSO – Mexican spotted owl

MSN – Most similar neighbor

NEPA – National Environmental Policy Act

NF – National Forest

PAC – Protected activity center (Mexican spotted owl)

PFA – Post-fledging family area (northern goshawk)

ROS – Recreation Opportunity Spectrum

SDI – Stand density index

SIO – Scenery integrity objectives

SMS – Scenery Management System

TCP – Traditional cultural property

TES – Terrestrial ecosystem survey

TPA – Trees per acre

ULM – Upper Lake Mary sub-watershed

USFWS – U.S. Fish and Wildlife Service

VMS – Visual Management System

VQO – Visual quality objective

VSS – Vegetative structural stages

WUI – Wildland-urban interface

Chapter 1. Purpose of and Need for Action

Document Structure

The Forest Service has prepared this Environmental Impact Statement in compliance with the National Environmental Policy Act (NEPA) and other relevant Federal and State laws and regulations. This Environmental Impact Statement discloses the direct, indirect, and cumulative environmental impacts that would result from the proposed action and alternatives. The document is organized into four chapters:

- *Chapter 1. Purpose and Need for Action:* The chapter includes information on the history of the project proposal, the purpose of and need for the project, and the agency's proposal for achieving that purpose and need. This section also details how the Forest Service informed the public of the proposal and how the public responded.
- *Chapter 2. Alternatives, including the Proposed Action:* This chapter provides a more detailed description of the agency's proposed action as well as alternative methods for achieving the stated purpose. These alternatives were developed based on significant issues raised by the public and other agencies. This discussion also includes all associated design features. Finally, this section provides a summary table of the environmental consequences associated with each alternative.
- *Chapter 3. Affected Environment and Environmental Consequences*: This chapter describes the environmental effects of implementing the proposed action and other alternatives. This analysis is organized by resource area.
- *Chapter 4. Consultation and Coordination:* This chapter provides a list of preparers and agencies consulted during the development of the environmental impact statement.
- *Chapter 5: References*: List of references used in the analyses, organized by resource area.
- *Appendices:* The appendices (A-C) provide more detailed information to support the analyses presented in the environmental impact statement such as the record index, public comments and responses, etc.
- *Index:* The index provides page numbers by document topic.

Additional documentation, including more detailed analyses of project-area resources, may be found in the project planning record located at the Flagstaff District Office on the Coconino National Forest.

Background

The City of Flagstaff has seen first-hand the devastating impacts of fire and post-fire flooding following the 2010 Schultz Fire on the east side of the San Francisco Peaks. The cost of fire suppression was approximately $10 million; however, the actual cost of the fire is many times greater than that figure. Many of those additional costs have been associated with severe, repeated flooding following the fire, with flows originating on the National Forest and traveling into semi-rural residential areas just outside the city limits. Almost four years after the actual wildfire, the Forest Service and Coconino County continue to work on mitigating the threat of flooding in those areas.

The Forest Service and the City of Flagstaff (also referred to throughout this document as "the City") are working together to reduce similar threats on National Forest System lands in the Dry Lake Hills area (Rio de Flag 6th HUC Watershed) north of Flagstaff (DLH) and on Mormon Mountain (Walnut Creek-Upper Lake Mary 6th HUC Watershed) south of town (MM), which is in a critical municipal watershed

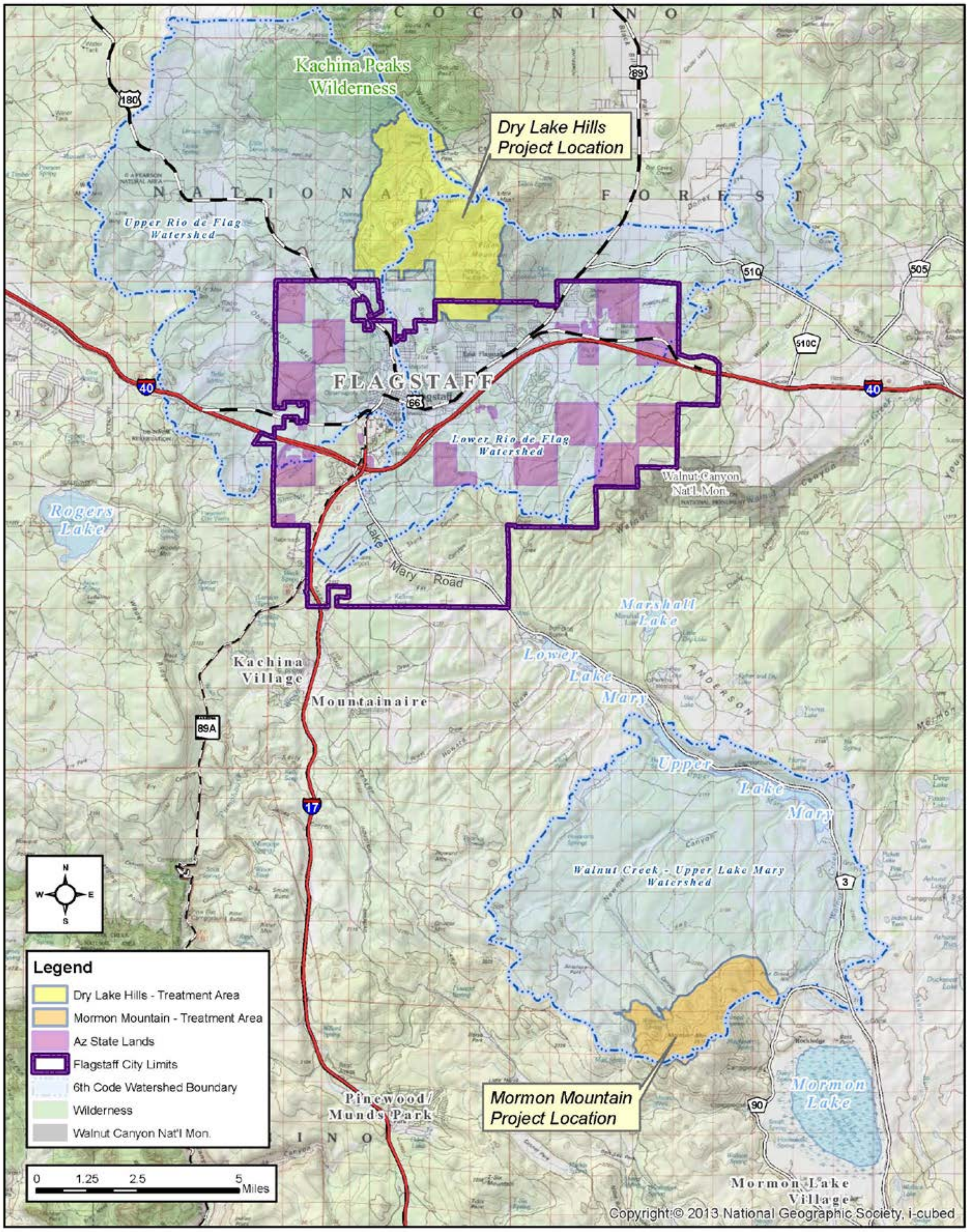
(Figure 1). Projections show that there could be severe flooding in parts of Flagstaff if a fire producing impacts to vegetation and soils similar to that which occurred form the Schultz fire were to occur on the slopes of the DLH, and that post-fire erosion following a similar fire in the Mormon Mountain area could impact the City's ability to utilize the Lake Mary Reservoir as a potable water supply, as this reservoir provides roughly 50 percent of the City's drinking water. During the November 2012 elections, residents of Flagstaff passed a $10 million bond with approximately 74 percent approval to support forest treatments within these two watersheds on the Coconino National Forest and also on State of Arizona lands. Identified on the ballot as the "Forest Health and Water Supply Protection Project," the planning effort on the National Forest segment is now known as the "Flagstaff Watershed Protection Project (FWPP)." Similar treatments may occur on approximately 3,000 acres of State of Arizona lands or on private lands, including an approximately 140-acre parcel in the middle of the Dry Lake Hills owned by the Navajo Nation, as part of the overarching project funded through the City bond; however these activities are not included in this FWPP EIS planning effort as it pertains strictly to those actions proposed on the National Forest. The implementation of watershed protection treatments on the National Forest System lands does not depend on the implementation of treatments on adjacent lands under other ownership. Treatments on adjacent lands will be included in the cumulative effects analysis portion of the FWPP EIS.

Project Milestones

On January 28, 2013, the City of Flagstaff was designated as a cooperating agency through the signing of a Memorandum of Understanding (MOU), which outlines the responsibilities of both the Forest Service and the City. This status allows a City representative to be a part of the Interdisciplinary Team (IDT) and also contribute technical expertise and information for the environmental assessment process.

In February, 2013 Forest leadership decided to change the level of analysis from an Environmental Assessment to an Environmental Impact Statement due to concerns identified by the IDT about potential impacts to the Mexican spotted owl and other forest resources. In March 2013, the USDA issued the final rule for project-level pre-decisional administration review process known as 36 CFR Part 218; FWPP is a project implementing the 1987 Coconino National Forest Plan, is not authorized under the Healthy Forest Restoration Act, and falls under this 36 CFR Part 218 regulation and therefore is subject to the new predecisional objection procedures.

Figure 1: General Vicinity Map[1]



[1] Ownership of a few parcels ofArizona State Lands has changed to the City of Flagstaff since this map was created. This does not affect the National Forest or management thereof.

Figure 1 shows the project area locations relative to the watersheds in which they are located. The yellow and orange areas depict the areas being analyzed in this DEIS for treatment. Chapter 2 contains information about which areas would actually be treated under each alternative.

The FWPP project area is of high scenic, cultural, wildlife, and recreational value. Public use of the project area is very heavy, with many heavily-used trails (for both motorized and non-motorized use), camping areas, and rock climbing areas. The area also has religious significance to several Native American tribes in the region.

Overlap between the Four Forests Restoration Initiative (4FRI) DEIS analysis area and the FWPP area is present; those areas that were analyzed by the 4FRI DEIS were included in this planning effort to address additional treatment options (such as treatments on steep slopes) and will not be carried forward into the 4FRI FEIS or Record of Decision. The Mount Elden/Dry Lake Hills (MEDL) Recreation Planning Project is also underway, and overlaps a majority of the project area within the Dry Lake Hills. While the purposes for the two projects differ, consistency between the proposed actions will be maintained as each moves through the analysis process to ensure there are no conflicts between proposals.

Currently about 1,872 acres within the general project boundary are already covered under previous NEPA decisions: Jack Smith/Schultz (2009) and Eastside (2007) Fuels Reduction and Forest Health Restoration Projects. The treatable areas covered under those decisions are either currently being implemented or will be implemented in the near future while the FWPP EIS planning process occurs on the rest of the project area. For example, the Orion Task Order (from the Jack Smith/Schultz Decision, 2009) is within the project boundary in the DLH area and is anticipated to be treated through the 4FRI contractor in 2014. Some areas within the Jack Smith/Schultz project area were either determined to be untreatable by ground-based equipment or were designated as No Treatment during that planning effort due to steep slopes and accessibility issues; those areas are being reanalyzed in the FWPP EIS.

Location

The analysis area contains two distinct areas: the DLH portion, which is north of Flagstaff, AZ, and the MM portion, which is south of Flagstaff (Figure 1). The DLH area is roughly bound by the City of Flagstaff to the south, Kachina Peaks Wilderness to the north, the watershed boundary to the east, and a closed forest road (FR 06275) to the west. The MM portion is located west of Forest Highway 3 (Lake Mary Road) and northwest of Mormon Lake and Mormon Lake Village, on the upper slopes of Mormon Mountain, and is generally bound by FR 132D to the north and FR 648 to the south.

Purpose and Need for Action

The primary purpose of the Flagstaff Watershed Protection Project (FWPP) is to reduce the potential of high severity wildfire and subsequent flooding in two key watersheds around Flagstaff, Arizona: in the Dry Lake Hills portion of the Rio de Flag Watershed, and the Mormon Mountain portion of the Walnut Creek-Upper Lake Mary Watershed (see Figure 1).

There is a need to reduce the potential of fire and post-fire flooding that would likely damage the drinking water infrastructure south of town and which could also cause extensive damage to residential and commercial areas should a high-intensity wildfire occur in mountainous areas that make-up the Upper Lake Mary and Rio de Flag watersheds.

More specifically, there is a need to reduce the potential for crown fire and high intensity surface fire, to reduce the likelihood of human-caused ignitions, and to increase the ability of fire suppression crews to control a wildfire occurring within the project area. In order to accomplish this, there is a need to amend the Forest Plan to allow mechanical treatment on slopes greater than 40 percent and a need to amend the

Forest Plan to better align treatments within the FWPP Mexican spotted owl habitats with the 2012 Recovery Plan.

The following sections on fire hazard, forest structure and health, and soil and water resources further detail the existing conditions, desired conditions, and the need for change.

Fire Risk

Several variables affect fire behavior on a site and over a landscape. Besides weather and terrain factors such as slope steepness, aspect, and landform type (chute, canyon, chimney, saddle, etc.), the variables that play the largest role in influencing fire behavior within a forest include dead and live fuel loadings, fuel moistures, crown bulk density (the volume of fuel available in tree crowns), crown base height (the height at which tree branches can be ignited by ground fire), and canopy closure (percentage of ground area vertically shaded by overhead foliage) (Agee and Skinner 2005).

These variables, depending on their structure and arrangement, can create many different fire behavior outcomes for a landscape. Intense fire behavior will most likely occur during hot, dry, and windy weather conditions under forest conditions of high fuel loadings, including a large number of trees per acre, large crown bulk densities, low crown base heights, and closed canopy conditions.

Existing Conditions

Existing conditions within the project area include dense stands with numerous dog-hair thickets on steep slopes with high fire risk (Figure 2), with a substantial wildland urban interface (Figure 3). Cover types in the project area include ponderosa pine, aspen, dry mixed conifer, wet mixed conifer, oak woodland, and grassland.

Figure 2: View of dense vegetation and steep slopes taken from within the DLH portion of the project area. The San Francisco Peaks are visible in the background.

Figure 3: Looking down on the City of Flagstaff from the communication site on Mount Elden, within the DLH portion of the project area.

Table 1 displays the wildfire occurrence over the last twenty years. Other than the Radio Fire (1977), which burned approximately 383 acres on Mt. Elden, the project areas have not experienced high severity fire or large fires in recorded history; therefore the 20 year time period was used as the best source of information relating to the project area.

Table 1: Wildfire Ignition Occurrence over the Past 20 years within FWPP

Past Wildfire Occurrence	Human Caused (total acres)	Lightning Caused (total acres)
Dry Lake Hills*	22 Fires (26.3 Acres)	40 Fires (83.2 Acres)
Mormon Mountain	4 Fires (0.5 Acres)	15 Fires (2.3 Acres)

*Wildfire Occurrence Analysis does not include the human caused Radio Fire (1977) that burned approximately 383 acres within the Dry Lake Hills Project Boundary as it occurred before the 20 year time period identified for this exercise.

Based on stand surveys completed in 2012 and 2013 on 6,621 acres within the project area, at least 71 percent of the surveyed area currently has a fire hazard rating of *extreme* (Table 2). Fire hazard ratings measure how intensely a fire would burn under hot, dry, and windy conditions during April through July, and include dead and down fuel loading (tons per acre), number of tree stems per acre, tree diameter, percent canopy closure, height to bottom of live crown (crown base height), tree height, slope and aspect in the calculations. As stand exams were completed on approximately 63 percent of the FWPP area, the numbers in Table 2 are a conservative estimate based on the areas that received stand exams. Because of the lack of fire within both project areas and knowledge of adjacent stand conditions, it is likely that the remaining unsurveyed acres would also be in the *high* to *extreme* rating.

Table 2: Fire Hazard Ratings for Acreages Surveyed within FWPP

Fire Hazard Rating	Dry Lake Hills[2]	Mormon Mountain[3]	Total Acres for FWPP	Percent of Total Area Surveyed
Extreme	2,582 acres	2,089 acres	4,671 acres	71%
Very High	72 acres	197 acres	269 acres	4%
High	613 acres	273 acres	886 acres	13%
Moderate	470 acres	174 acres	644 acres	10%
Low	100 acres	51 acres	151 acres	2%

There is also a high departure from historic vegetation conditions and fire return intervals within most of the project area (Figure 5 and Figure 6). In general, fire regimes[4] in the analysis area have shifted from historically more frequent, lower-intensity surface fires (Fire Regime I and III, Condition Class I) to less frequent, higher-intensity crown fires (Condition Class[5] III). See also Figure 4. This departure has created conditions where, if a wildfire were to occur, there would likely be more severe effects to ecosystem components (trees, soil, wildlife) than would have occurred under the natural fire regime.

2 Based on the 3,837 acres survey in the DLH (roughly 51% of the Dry Lake Hills area)
3 Based on the 2,784 acres surveyed on Mormon Mountain (roughly 93% of the Mormon Mt. area)
4 A fire regime classifies the role of fire over the landscape in the absence of modern human mechanical intervention. There are five natural fire regimes that are characterized based on average numbers of years between fires combined with fire severity of the dominant overstory vegetation. Fire Regime I (FRI) indicates a landscape with frequent fires (0-35 years) with surface to mixed burn severity. Fire Regime III (FRIII) indicates a landscape with fires every 35 to 200 years, with low to mixed burn severity.
5 Condition Class refers to the level of departure from the historic fire regime. CC1 means the departure is slight, while CC3 means there is a great departure. See also Table 30.

Figure 4: Natural Fire Regime Groups (from the Interagency Fire Regime Condition Class Guidebook, Sept. 2010)

Group	Frequency	Severity	Severity description
I	0 – 35 years	Low / mixed	Generally low-severity fires replacing less than 25% of the dominant overstory vegetation; can include mixed-severity fires that replace up to 75% of the overstory
II	0 – 35 years	Replacement	High-severity fires replacing greater than 75% of the dominant overstory vegetation
III	35 – 200 years	Mixed / low	Generally mixed-severity; can also include low-severity fires
IV	35 – 200 years	Replacement	High-severity fires
V	200+ years	Replacement / any severity	Generally replacement-severity; can include any severity type in this frequency range

A minority of the project area includes vegetation that likely naturally burned at moderate or high intensities during historic conditions. While these vegetation types are limited in the project area, these too would be treated to limit the potential for crown fire and subsequent flooding in and downstream of the project area; however frequent low-severity fire would not be introduced into wet mixed conifer forest types. Frequent surface fire would either fail to carry due to lack of long-needle conifer litter and bunchgrasses, or the surface fire would result in unacceptably high cambial and root scorch and very high forest mortality. Surface fires are not characteristic or appropriate for these forest types.

Figure 5: Historic picture of Mount Elden from 1895 (photo courtesy of the NAU Archives)

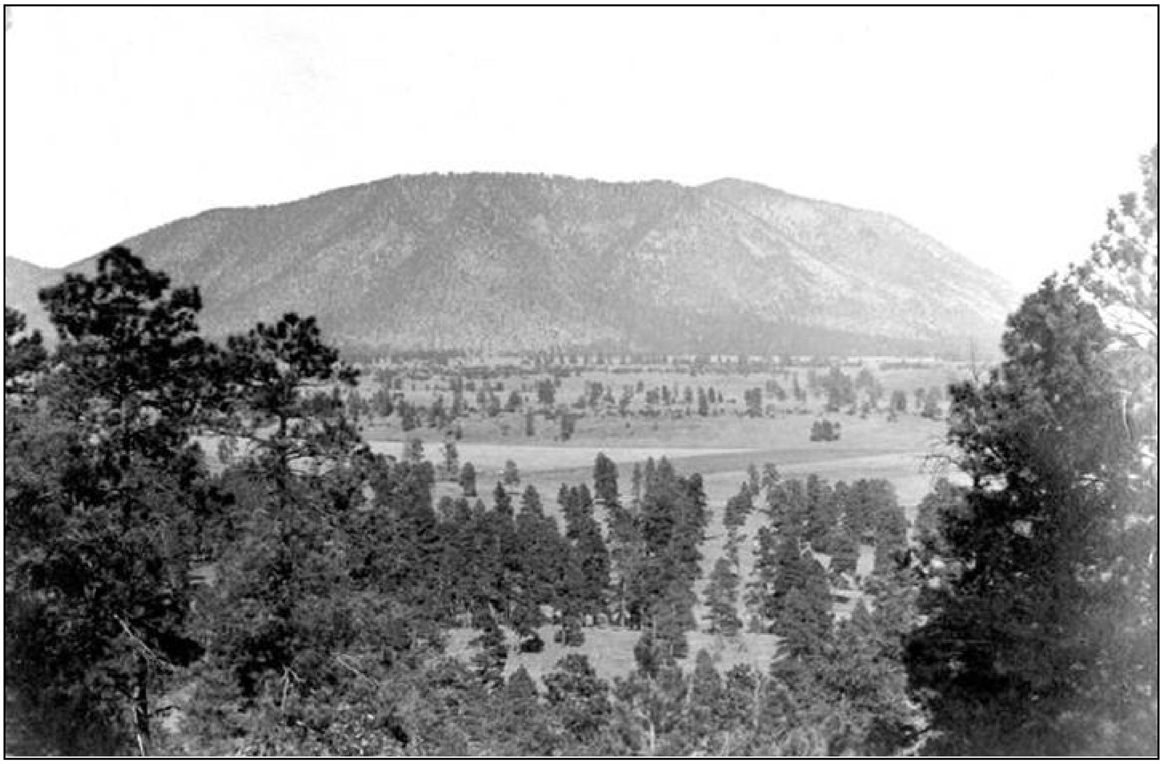
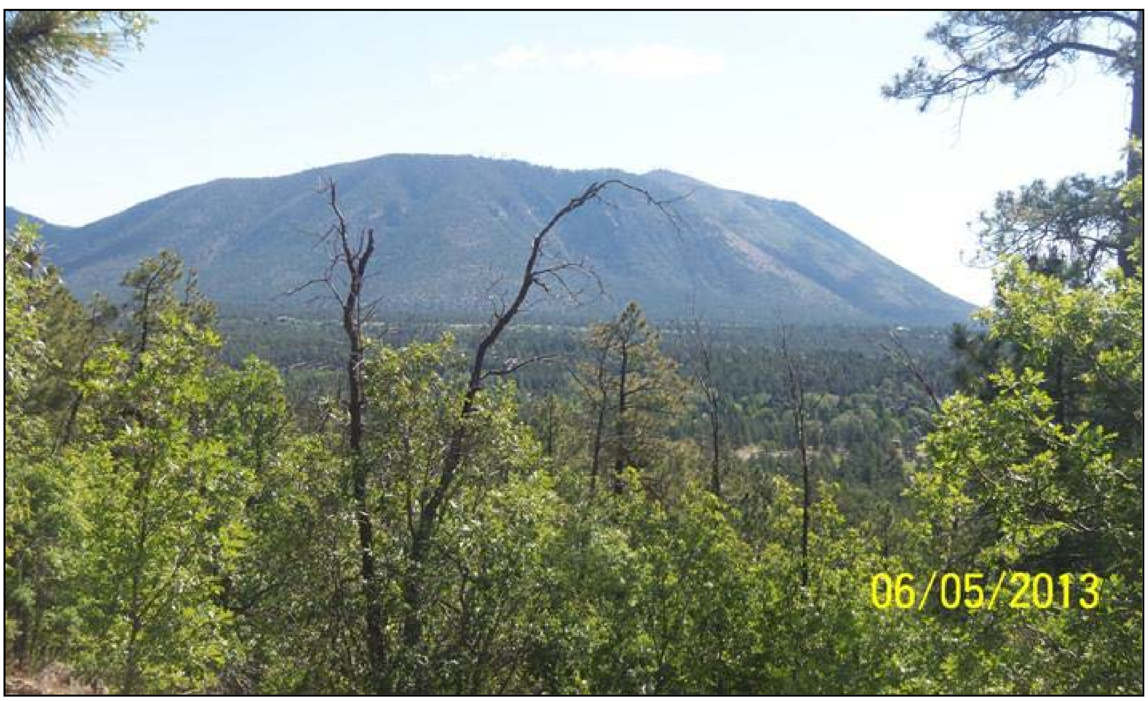


Figure 6: Reference photo of Mount Elden taken on June 5, 2013



Crown fire potential was also analyzed for both project areas using data generated from modeling performed using FlamMap 3.0. Three types of fires result from the modeling: **surface fire**, **passive crown fire**, and **active crown fire**. Surface fire describes fire that burns through the surface fuels of the forest floor. This type of fire has the least active of fire behaviors and is the most beneficial of the three types of fires in maintaining the historical, ecological role of low intensity, high frequency fire in the southwestern ponderosa pine ecosystem. Passive crown fire, or torching, occurs when flame lengths are long enough to reach the lower edge of the canopy and can result in individual or small group tree torching but does not proliferate through the forest canopy through continuous crown fire spread. Active crown fire occurs when flames reach the forest canopy and spread through it with intensity and continuity.

The fuel moisture and weather characteristics used to model the effects and behavior of a potential wildfire for existing and desired conditions are 97th percentile conditions from the Flagstaff RAWS station and observed conditions on the Schultz fire on June 20th, 2010. The conditions used were as follows:

<u>97th Percentile Conditions</u>

- 1-hour fuel moisture: 2%
- 10-hour fuel moisture: 2%
- 100- hour fuel moisture: 4%
- 1000- hour fuel moisture: 7%
- 20-foot wind speed: 25 mph
- Air temperature: 85^{0}F

<u>Schultz Fire Conditions</u>

- 1-hour fuel moisture: 3%
- 10-hour fuel moisture: 3%
- 100- hour fuel moisture: 6%
- 1000- hour fuel moisture: 11%
- 20-foot wind speed: 23 mph
- Air temperature: 74^{0}F

The 97th percentile and the Schultz Fire weather conditions were used in modeling to give an overall worst case scenario in terms of crown fire potential, and also a comparable local reference. The 97th percentile conditions represent the top three percent (3%) worst fire weather days from 2002-2011, and the Schultz Fire was one of the biggest high intensity/stand replacing fires that has occurred recently within fifteen miles of Flagstaff, Arizona.

Table 3: Crown Fire Potential (97th percentile) for the Project Area (with percent of project area)[6]

CROWN FIRE POTENTIAL	DRY LAKE HILLS	MORMON MOUNTAIN	TOTALS
Surface Fire	1,426 acres (19%)	286 acres (10%)	1,712 acres (16%)
Passive Crown Fire	557 acres (7%)	481 acres (16%)	1,038 acres (10%)
Active Crown Fire	5,480 acres (73%)	2,201 acres (74%)	7,681 acres (74%)
TOTALS	**7,463 modeled acres**	**2,968 modeled acres**	**10,431 modeled acres**

[6] Acreages and percentages may differ slightly between tables due to rounding. Approximately 18 acres were also classified as “no data” for use in this model; modeled acreages only cover forested vegetation and do not include the aproximately 93 non-forested acres within the project area.

Table 4: Crown Fire Potential (Schultz Fire Conditions) for the Project Area (with percent of project area)

CROWN FIRE POTENTIAL	DRY LAKE HILLS	MORMON MOUNTAIN	TOTALS
Surface Fire	2,881 acres (39%)	176 acres (6%)	3,057 acres (29%)
Passive Crown Fire	749 acres (10%)	725 acres (24%)	1,474 acres (14%)
Active Crown Fire	3,832 acres (51%)	2,068 acres (70%)	5,900 acres (57%)
TOTALS	**7,462 modeled acres**	**2,969 modeled acres**	**10,431 modeled acres**

Desired Conditions

The desired condition for the project area is to be able to support low intensity, frequent surface fires according to the historical fire regime for the vegetation type. For the majority of the project area, the desired condition is to decrease the magnitude of departure from historic conditions, and return the majority of the analysis area in FRI and FRIII to Condition Class 1.

Desired future conditions include fewer ladder fuels and dead vegetation on the forest floor (dead and down fuel) and the heavy fuel live fuel loading (stems per acre), a more open forest structure according to historical vegetative conditions and fire regimes. Desired conditions also include reducing potential fire intensity so that more of the project area would experience surface fire with low soil burn severity instead of active or passive crown fire with high soil burn severity.

Need for Change

The purpose of FWPP is to reduce the risk of high severity wildfire and subsequent high severity flooding in two key watersheds around the City of Flagstaff. To address the need for fuel reduction as directed in the Forest Plan, there is a need to meet the following objectives of fuel treatments:

1) There is a need to reduce the probability of crown fire initiation. This is achieved by accomplishing the following across the project areas.

a. Reducing the crown bulk density (the mass per volume of available canopy fuels).
b. Increasing the canopy base height (the height at which tree branches can be ignited by ground fire).
c. Reducing the potential flame length (e.g. the intensity of the fire).

2) There is a need to establish and maintain forest conditions where wildfires remain on the ground surface. This is achieved by reducing the percent of canopy closure, in addition to those methods described above to reduce crown fire initiation.

3) There is a need to reduce the potential for spot fires. This can also be achieved by reducing the crown bulk density and amount of surface fuel, by increasing the effective crown base height, and by reducing the expected flame length.

4) There is a need for the proposed treatments to maintain these objectives for as long as possible by implementing periodic prescribed burning without executing additional thinning treatments.

Forest Structure and Forest Health

Existing Conditions

The Existing Conditions section will go through the cover types present within the project area first, followed by a discussion of Mexican spotted owl (MSO) habitat and northern goshawk habitat conditions (in terms of forest density and structure), old growth, then forest health.

Cover Types

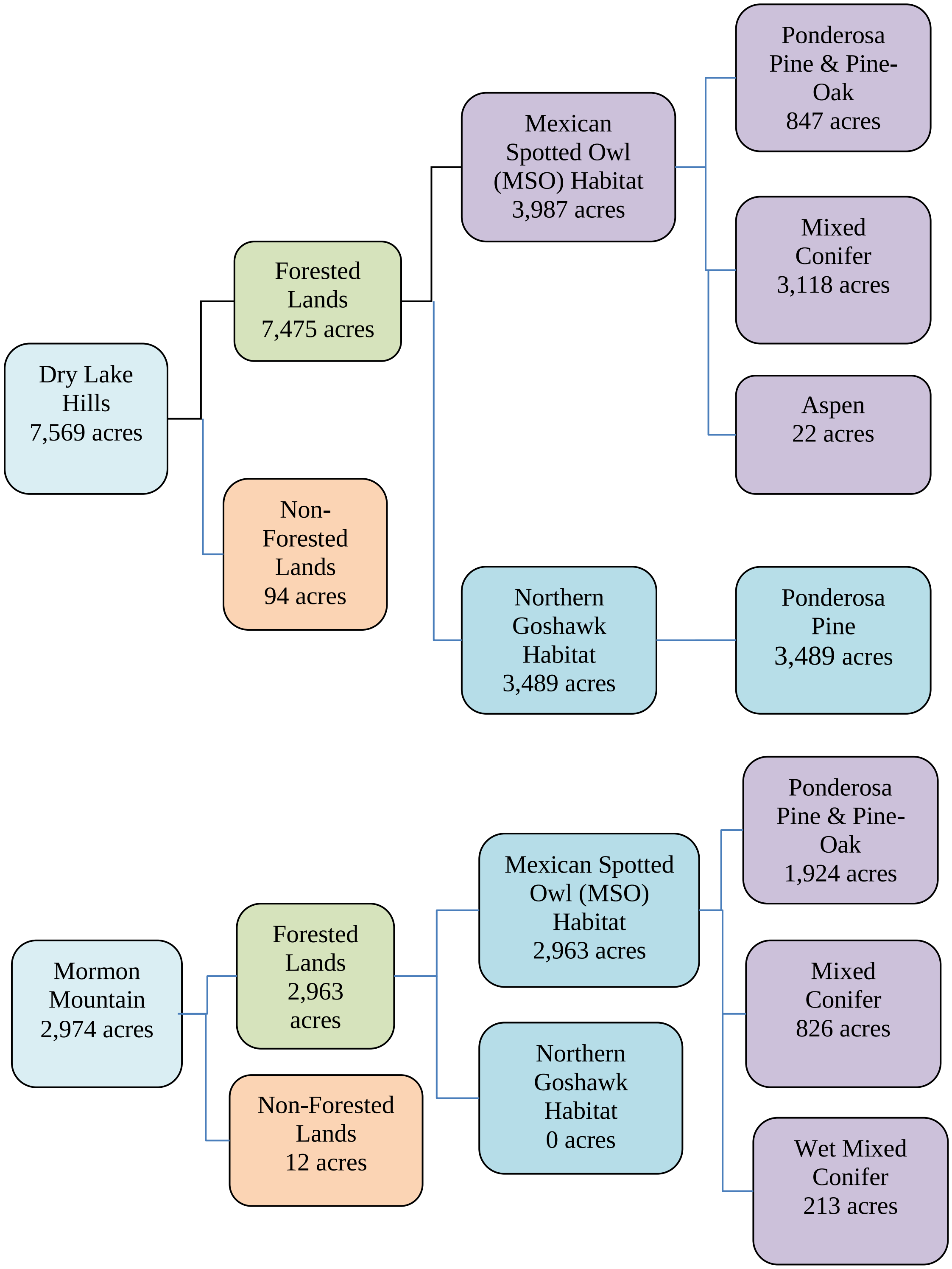
Cover types are divided into three broad categories that describe vegetative state – non-vegetated, non-forest or forest. The following is a description of the cover types that occur within the analysis area. Table 5 below lists the acres within the analysis area by cover type. Figure 7 displays the breakdown of acres of MSO and northern goshawk habitat and their cover types in both the DLH and MM portions.

Table 5: Analysis Area Cover Type Acres

Cover Type	DLH	MM	Total
Non-Vegetated			
Barren (Right of Ways)	33	0	**33**
Non-Forest Communities			
Grassland	60	0	**60**
Forest Communities			
Ponderosa Pine*	4336	1924	**6260**
Dry Mixed Conifer	3118	838	**3956**
Wet Mixed Conifer	0	213	**213**
Aspen	22	0	**22**
Total Forested Acres:	**7,476**	**2,975**	**10,451**
Total Analysis Area Acres:	**7,569**	**2,975**	**10,544**

*Includes areas of Pine-Oak

Figure 7: Stratification of forested and non-forested lands within FWPP



Ponderosa Pine

The ponderosa pine forest vegetation community within the project occurs at elevations ranging from 7,000 to 9,200 feet. It is dominated by ponderosa pine and commonly includes other species such as oak, juniper. Species such as aspen, Douglas-fir, white fir, southwestern white pine (limber pine) and pinyon may also be present, but occur infrequently as small groups or individual trees. This forest vegetation community typically occurs with an understory of grasses and forbs, although it sometimes includes shrubs.

Historically, ponderosa pine forests of northern Arizona were characterized by frequent, low-intensity surface fires occurring every 2 to 12 years. The historic fire regime maintained an open canopy structure and a variable, patchy tree distribution across much of the forest by thinning smaller trees (Moir et al. 1997, Covington et al. 1997, Heinlein et al. 2005).

Ponderosa pine commonly grows in pure stands and currently is found in even-aged[7] and uneven-aged[8] structural conditions across the area. The open park-like stands characteristic of the reference conditions for ponderosa pine forests promoted greater faunal diversity and fire resilience than the dense, closed-canopy stands of today. Ponderosa pine forests within the project are generally denser and more continuous than in reference conditions, and accumulations of forest litter and woody debris are much higher than would have occurred under the historic disturbance regime.

Gambel Oak within Ponderosa Pine Forest

Gambel oak is frequently the only deciduous tree in otherwise pure southwestern ponderosa pine forests, adding diversity to these forests. A portion of the stands have a large enough component of Gambel oak to be considered pine-oak habitat for MSO (as described in the Forest Plan and MSO Recovery Plan). Similar to pure ponderosa pine forests, pine-Gambel oak forests have become altered since Euro-American settlement in the late 1800s, resulting in an overall increase in small- and medium sized Gambel oak stems and a more simplified forest structure (Abella 2008). Management strategies for Gambel oak include conservation of all existing large or old individuals, conducting treatments to increase the health and productivity of large oaks and only cutting oaks where necessary for operational reasons.

Understory Vegetation within Ponderosa Pine Forest

Herbaceous vegetation (grass and forbs) are a major understory associate within the ponderosa pine plant associations throughout the analysis area. Research at the Fort Valley Experimental Forest, located very near the project area, has shown that substantial declines in herbaceous vegetation diversity and growth have occurred over the past century due to increased tree density, increased canopy covers, and increased forest floor depth (Covington et al 1997). This trend indicates a shift away from a more diverse balance across a broad variety of understory plants to productivity dominated by pine trees.

Woodland species with in the Ponderosa Pine Forest

On slopes with southern aspects, scattered groups and individuals of woodland species may be found within the ponderosa pine forests. Species include pinyon pine, alligator juniper, one-seed juniper, rocky mountain juniper, and Utah juniper. These species have increased in density and

[7] Even-aged – pertaining to a stand composed of a single age class in which the tree ages are within + 20 percent variability based upon the mature stand age (SAF 1998).

[8] Uneven-aged – pertaining to a stand with trees of three or more distinct age classes (SAF 1998).

spread over a wider area since the advent of Euro-American settlement and the suppression wildfires. Management strategies for woodland species within this project would include conservation of all existing large or old individuals, maintaining a variety of growth forms, managing for a range of densities and population locations.

Dry and Wet Mixed Conifer

The mixed conifer vegetation communities within the project area occur from 7,200 to 9,200 feet elevation, and occur as two separate types, referred to in this report as “dry” and “wet.” Due to the frequent disturbance regime, historic dry mixed conifer forests were dominated by fire resistant, shade-intolerant conifer species such as ponderosa pine, southwestern white pine, and Douglas-fir. Historically shade-tolerant species were absent or present as a minor stand component on the drier sites such as ridge tops and southwest-facing slopes, with more abundant but still subdominant representation on cooler, wetter, north-facing slopes (Heinlen et al. 2005.

Currently, dry mixed conifer forests within the project area are dominated by ponderosa pine, Douglas-fir, southwestern white pine, and white fir. Aspen is an early seral species and occurs frequently throughout the mixed conifer areas. Southwestern white pine does not occur in the Mormon Mountain portion of the project. Wet mixed conifer only occurs on the MM portion of the project are (a, and also includes white-fir, Douglas-fir, aspen, and maple. Dry mixed conifer types tend to be on lower north facing slopes or higher elevation south facing slopes and are more open than the wet types. The wet mixed conifer types typically occur at higher elevations and on north facing slopes.

In dry and wet mixed conifer forests, habitat types are usually intermingled in relatively small areas, such as opposing aspects of the same hillside. The area of wet mixed conifer identified on Mormon Mountain is a contiguous 213 acre area.

Historically the dry type experienced relatively frequent low to moderate intensity fire (every 2 to 21 years) (Heinlen et al. 2005, Swetnam 1996), similar to ponderosa pine forests, and were typically uneven aged, growing in a patchy structure. In the wet types, fires were less frequent but generally of a higher intensity and severity, resulting in larger patches of homogeneous tree ages and higher patch density overall (Smith 2006, Margolis et. al. 2011). Wet mixed conifer vegetation types are found where historically fires occurred infrequently.

Studies to date indicate that tree density of warm/dry mixed-conifer forests ranged from about 21 to 99 trees per acre while basal area varied from 34 to 124 ft2 per acre, prior to Euro-American settlement of the region (Stoddard 2011). Low-severity surface fires, burning at intervals of 4 to 30 years, limited establishment of tree seedlings, and many forests were more open than today. Although information about tree spatial patterns in mixed-conifer is very limited, frequent fire in dry forest types of western North America is thought to promote fine-scale heterogeneity characterized by mosaics of openings, single trees, and groups of trees with interlocking crowns (Larson and Churchill 2012). In the absence of repeated fires, openings fill-in with regenerating trees and stands increase in spatial homogeneity. For example, at a warm/dry mixed-conifer site in southern Colorado, Fulé et al. (2009) found that tree density increased by a factor of nearly five and stand basal area more than doubled from the time of fire regime disruption in 1870 to the time of study in 2003. Similar changes were found by Cocke et al. (2005) in the mixed-conifer zone on the San Francisco Peaks in northern Arizona. Heinlein et al. (2005) studied smaller sites on the San Francisco Peaks and found that tree density and basal area had increased since fire-regime disruption by factors of up to 31 and 4, respectively. Fulé et al. (2003) identified substantial, yet smaller, changes in tree density and basal area following fire-regime disruption at a mixed-conifer site on the North Rim of Grand Canyon National Park.

Dry mixed conifer forests within the project are generally denser and more continuous than in reference conditions, and accumulations of forest litter and woody debris are much higher than would have occurred under the historic disturbance regime. Lack of fire disturbance has led to increased tree density and fuel loads that increase the risk of uncharacteristically intense wildfire and drought-related mortality. When fires occur under current conditions, they tend to kill a lot of trees, including the large and old trees. These trees take longer to replace, moving the forest further from desired conditions, and increasing the time it would take to return to desired conditions. There is a high risk of insect and/or disease outbreak, which is also a function of increased tree density (see Forest Health Section).

Wet mixed conifer forest within the project, may or may not be highly departed from reference conditions. The wet mixed conifer forest in this project does not contain any Engelmann spruce or sub-alpine fire. Wet mixed conifer forests that contain those two species are considered to be high severity stand replacing fire regimes. The wet mixed conifer in this project contains White Fir, Douglas-fir, scattered Aspen patches and occasional ponderosa pine which indicates that the fire regime may be that of a more mixed severity than stand replacing.

Aspen

An accelerated decline of aspen occurred across the project area following a frost event in June 1999, a long-term drought that included an extremely dry and warm period from 2001 through 2002, and bouts of defoliation by the western tent caterpillar in 2004, 2005, and 2007. Surveys across the Coconino National Forest have shown that aspen on low-elevation xeric sites (<7500 ft) sustained 95 percent mortality since 2000. Mid-elevation sites (7500–8500 ft) lost 61 percent of aspen stems during the same time period; mortality is expected to continue in these sites because some remaining trees have 70 to 90 percent crown dieback.

Within the project area, quaking aspen is limited to small patches within a larger forest matrix dominated by ponderosa pine or mixed conifer vegetation (see Figure 56 in Chapter 3). These patches consist of a few overstory trees with a sapling understory component. There is one 22 acre stand of pure aspen in the DLH which was created by post fire regeneration after the 1977 Radio fire.

Aspen reproduces asexually through root suckers that are a clone of the original parent tree. Fire, insect, disease, wind and human disturbances regenerate this shade-intolerant species by opening up the canopy and removing conifers from the understory. Without disturbance, conifers gradually overtop aspen, closing the canopy and eventually killing mature trees and reducing regeneration. Aspen is highly susceptible to browsing and disease or death due to bark injuries. Aspen patches are regenerating successfully where livestock and wildlife are excluded by fencing. Several aspen patches within the project area show signs of decline marked by mortality and dieback of crowns, similar to what has been observed across Arizona over the past several years (Fairweather et al. 2008).

Grasslands

Grasslands within the project area typically occur between 7,000 and 9,000 feet in elevation and are categorized as the productive Montane/Subalpine and the more arid Colorado Plateau/Great Basin. Approximately 60 acres within the analysis area are classified as grassland cover type based on stand data. A wide variety of species of grasses, forbs, shrubs and/or trees characterize their vegetation which varies according to soil type, soil moisture, and temperature.

Historically, these grasslands had less than 10 percent tree cover. The grassland cover type has experienced some degree of conifer (ponderosa pine and mixed conifer) encroachment over the last 100 years as a result of fire exclusion and grazing use. Many of the pre-settlement trees that grew along the edges of these grasslands were removed historically. These edges as well as much of the interior of the grasslands have become stocked by sapling and young to mid-aged trees. These trees are growing rapidly due to the open growing conditions and a lack of competition.

Old Growth

The old growth specifications for ponderosa pine, mixed conifer and aspen cover types can be found in the Forest Plan on pages 70-72. Table 6 shows the acres of existing old growth broken out by cover type and overall percent of each cover type that meets the current standard of existing old growth.

Table 6: Acres and percent of existing old growth by cover type and site potential located within FWPP.

Project Area	Cover Type	Acres of Cover Type	Acres of Currently Allocated	% Old Growth	Acres needed for 20%
Dry Lake Hills	Interior Ponderosa Pine – High	4336	1183	27%	0
	Mixed Species Group – High (Mixed Conifer)	3118	1450	47%	0
	Aspen	22	0	0%	4
Mormon Mountain	Interior Ponderosa Pine – High	1924	53	3%	332
	Mixed Species Group – High (Mixed Conifer)	1051	561	53%	0

According to the Forest Plan, old-growth forest should also be analyzed at multiple scales – one scale above and one scale below the ecosystem management areas. The three scales used to analyze old-growth for this project include:

- *Small scale* – Individual stands were evaluated for existing old growth conditions and or suitability for managing towards old growth conditions.
- *Mid-scale* - the ecosystem management area level. EMA was chosen due to Forest Plan direction.
- *Large scale* - across the Coconino National Forest.

This analysis only looks at the forest types that occur and would be managed in this project. They include ponderosa pine, mixed conifer, and aspen. More information about the old growth analysis scales and existing conditions can be found in the Silviculture Specialist Report, located in the project record.

Forest Health

For the purposes of this analysis, forest health is defined by the vigor and condition of the forest stands and the presence of insects and disease that affect the sustainability of the forest. A working definition of a healthy forest is a forest where:

- Native insect and disease activity is within the historic range of variability, and non-native insects/diseases are absent or incidental;
- Stand densities are at levels that facilitate overall forest development, tree vigor, and resilience to characteristic disturbances;
- Forest structure represents all age classes necessary for a sustainable balance of regeneration, growth, mortality and decomposition;
- Overall these conditions are resilient to natural biotic and abiotic disturbances (e.g., fire, insects, diseases, and wind).

Southwestern ecosystems have evolved under a long and complex history of climate variability and change. Taking into consideration the number of mega-droughts and other climate-related variation through time, southwestern systems have some built-in resilience. Risks of increased wildfire, insects and disease outbreaks, and invasive species represent ongoing, broad-scale management challenges. These issues are not new. However, climate change has the potential to increase and exacerbate the impacts of these ecosystem dangers.

The hypothesis that increases in temperature will lead to upward elevation shifts of montane species is already being observed in Arizona (Brusca et al. 2013). Climate change is also expected to affect the timing of prescribed burning intervals to maintain forest thinning treatments (Diggins et al. 2010). Drought stress and mortality in the coming decades are likely to lead to rapid shifts in southwestern forests, significantly altering species composition, forest structure and fuel loading (Flannigan, Stocks and Wotton 2000).

Based on current projections, the primary regional-level effects of climate change most likely to occur in the Southwest that would have an effect on forest vegetation include warmer temperatures, decreasing precipitation, and increased extreme weather events. These changes could result in immediate vegetation disturbance due to wind or flooding, increased wildfire hazard, increased outbreaks of insects, diseases, and spread of invasive species, increased drought related mortality and changes in plant species composition. It is predicted by climate models that the average forest drought stress by the 2050s will exceed that of the most severe droughts in the past 1000 years (Williams et al. 2012).

Aspen Mortality

According to the 2008 Fairweather et al. report, aspen on the Coconino National Forest have been in decline over the past decade. Several insects and pathogens were associated with aspen mortality but appeared to be acting as secondary agents on stressed trees. Aspen regeneration occurred to some degree on all the sites studied following the death of mature trees, although aspen sprouts were nearly nonexistent by the summer of 2007. This loss of spouts was attributed to browsing by elk and deer as none of the sites studied were grazed currently by domestic cattle. Widespread mortality of mature aspen trees, chronic browsing by ungulates, and advanced conifer reproduction is expected to result in rapid vegetation change of many ecologically unique and important sites (Fairweather et. al. 2008). The annual Forest Health Protection aerial survey conducted in 2010 (USDA FS 2011) indicated a continuation of the mortality trend within the project area.

Bark Beetles

An outbreak of bark beetles, starting in 2002 to 2003, resulted in widespread mortality across Arizona, including mortality in the project area. The outbreak was primarily the result of several native bark beetle species responding to the weakened condition of moisture-stressed, over-crowded forests. Trees on stress-prone sites were most affected. A decrease in affected acres began to occur in 2007 (USDA FS 2008).

The annual aerial surveys on the Coconino National Forest in the summer of 2012 detected mortality associated with bark beetles on approximately 520 acres of ponderosa pine and mixed conifer within the project area. This mortality is most likely associated with the ips beetle and western pine beetle. The previous year’s survey (2011) showed only six acres of mortality within the project area.

Research in the West clearly shows that when trees are stressed from overstocking they are more susceptible to bark beetle attack (DeMars and Roettgering 1982, Schmid and Mata 1992, Schmid et al. 1994, Chojnacky et al. 2000, Negrón et al. 2000,). During the recent landscape-level bark beetle outbreak in Arizona, elevation and tree density were significant variables for estimating the probability of occurrence of mortality in ponderosa pine stands on several forests (Negrón et al. 2009). Dwarf mistletoe infection also appears to influence attack patterns of bark beetles on ponderosa pine during drought events (Kenaley et al. 2006, 2008).

A general bark beetle hazard model for southwestern ponderosa pine based exclusively on the tree density relationships developed in the *Dendroctonus* hazard model by Munson and Anhold 1995 (as documented in Chojnacky et al. 2000) and the draft *Ips* hazard model developed by McMillin et al. (2011) indicates that stands of ponderosa pine within the project area with a relative density below 30 percent of SDImax have a low hazard rating and stands between 30 and 40 percent of SDImax have a moderate hazard rating. Using these relative density thresholds, approximately 11 percent of the DLH analysis area has a low bark beetle hazard rating, while 13 percent of the area has a moderate rating and the remaining 76 percent has a high hazard of beetle attack (Table 7). For the MM area, approximately 3 percent is rated at low hazard and the remaining 97 percent is rated as high hazard for bark beetle mortality.

Table 7: Existing Ponderosa Pine Beetle Hazard Rating (Percent of stands in each Project Area)

Cover Type	Hazard Rating	Dry Lake Hills	Mormon Mountain
Pine	Low	11%	3%
Pine	Moderate	13%	0%

Cover Type	Hazard Rating	Dry Lake Hills	Mormon Mountain
Pine	High	76%	97%
Mixed Conifer	Low	0%	27%
Mixed Conifer	Moderate	5%	0%
Mixed Conifer	High	95%	73%

Dwarf Mistletoe

Dwarf mistletoes are the most widespread and damaging forest pathogens (disease-causing organisms) in the Southwest. Damage from dwarf mistletoes includes growth reduction, deformity—especially the characteristic witches' brooms, and decreased longevity. Infected areas often have much higher mortality rates than uninfected areas. Infection is often a major factor in mortality attributed to other damaging agents. For example, severely infected trees are often attacked by bark beetles (USDA Forest Service 2011).

Southwestern dwarf mistletoe infection in ponderosa pine is common throughout the ponderosa pine analysis area. On both the stand and landscape level, the distribution of dwarf mistletoes is usually patchy, with more or less discrete infection centers surrounded by areas without the disease. Infection centers expand very slowly, so overall incidence changes little from year to year (USDA Forest Service 2011).

Table 8 displays ponderosa pine dwarf mistletoe infection in terms of area by infection level for both ponderosa pine and mixed conifer. Within the mixed conifer, ponderosa pine and Doulas-fir are the two predominate tree species infected with mistletoe. The area with the highest level of infection is within the ponderosa pine in the DLH. Approximately 37 percent of the area is either not infected or has a low infection level. Thirty four percent of the area is moderately or heavily infected. The remaining 29 percent is severely infected.

Table 8: EC - Dwarf Mistletoe Infection Level of ponderosa pine and mixed conifer within FWPP

Cover Type	Infection Level		Dry Lake Hills	Mormon Mountain
Pine	None/Low	Percent of Area	37%	69%
Pine	Moderate/High	Percent of Area	34%	31%
Pine	Severe	Percent of Area	29%	0%
Mixed Conifer	None/Low	Percent of Area	80%	91%
Mixed Conifer	Moderate/High	Percent of Area	20%	9%

Cover Type	Infection Level		Dry Lake Hills	Mormon Mountain
Mixed Conifer	Severe	Percent of Area	0%	0%

Desired Conditions

Supporting Science

The project desired conditions have been developed based upon the project Purpose and Need and Forest Plan direction for forest vegetation management. Current best available science was used for analysis of conditions necessary to meet the project Purpose and Need. Science relative to historic reference conditions has informed this process.

The Desired Conditions for ponderosa pine forests incorporated information on the ecology of the overstory and understory vegetation comprising this type as well as information on its historic or natural range of variability in the composition, structure and pattern of vegetation.

Restoring southwestern ponderosa pine forests revolves around reintroducing a regime of frequent, low-intensity fires like those that historically maintained forest structure and function (Friederici 2004). Forest treatments that include prescribed burning, often preceded by thinning to reduce fuel loads, have the potential to improve the ecological health of these forests. In order to wisely set the goals that underlie these treatments, it is useful for us to know as much as possible about past forest conditions, especially the "reference conditions" that existed before forest structure and function were altered by Euro-American settlers. Such conditions were not unchanging, but they sustained themselves across what has been called a "natural range of variability" (Friederici 2004).

The natural range of variability (NRV) specific to the Flagstaff Watershed Protection Project area comes from early written records, general land office surveys, Forest Service records, oral histories, and photographs as well as old forest remnants, physical remains of old trees and dendrochronology. For example, Cooper (1960) researched the cultural evidence to document the historic condition of southwestern pine forests. Many early travelers, surveyors and government officials left records of their impressions of pine forest country specific to the project area. The 19th century descriptions of ponderosa pine forest conditions by the likes of Lt. Edward Beale, Lt. Ives, C. Hart Merriam, J.B. Lieberg, S.J. Holsinger could be summarized as follows: "The forest was decidedly open and park like; reproduction was not abundant, and in many areas was markedly deficient; grass was abundant but not universal" (Cooper 1960). Other documentation that has informed our current understanding of the NRV includes plot data by early scientists (Woolsey 1911, Pearson 1950), tree ring, dendrochronological, and restoration studies (Covington and Moore 1994, Swetnam and Baisan 1996, Covington et al. 1997), natural area and old growth studies (White 1985), and wildland fuel management strategies (Pearson 1950, and Fule et al. 1997). The following is a NRV description based on these and many other references.

Natural Range of Variability

All southwestern forests and woodlands are periodically affected by natural disturbances such as fire, insects, disease, wind, and herbivory (Mast et al. 1998 and 1999, Brown et al. 2001, Ehle and Baker 2003). These disturbances have variable effects on forest vegetation depending on the type, frequency, intensity, and spatial scale of disturbances. The type, frequency, and intensity of disturbances varied historically among forest and woodland types. A forest or woodland's characteristic composition, structure, and landscape pattern, the result of vegetation establishment, growth, and succession, combined with the periodic resetting of these by characteristic natural disturbances, constitutes a forest or woodland's natural range of variability. The temporal and spatial variability in vegetation establishment, growth, and mortality, and the consequences of natural disturbances in a forest or woodland define the natural range of variability. Much of the range of variability stems from fine- to landscape scale heterogeneity in aspect, slope, elevation, and soils that can lead to topographically different growing conditions and disturbance regimes (Fule et al. 2003). The ability of a forest ecosystem to absorb and recover from disturbances without drastic alteration of its inherent function is central to the concept of natural range of variability. In the southwestern United States, fire is a primary disturbance agent and fire regimes are central to understanding natural range of variability as it relates to the composition, structure, and pattern in various forest types (Fule et al. 2003).

Species Composition

In this type, ponderosa pine is the dominant seral and climax tree species, but depending on locale may mix with gamble oak, several juniper and pinyon species, quaking aspen, Douglas-fir, limber pine, white fir, or white pine (USDA 1997). Composition of the grass/forb/shrub understory is typically diverse in ponderosa pine forests, especially when canopy openings are present (Moir 1966, Naumburg and Dewald 1999, Laughlin et al. 2006, Abella et al. 2011). Presence of shrubs is variable depending on habitat type and locale (USDA 1997). While grasses and herbs occur in most ponderosa pine types (USDA 1997), the composition, abundance (cover), and productivity is variable depending on soil, aspect, elevation, latitude, moisture, and the presence or absence of tree cover (Moir 1966, Naumburg and Dewald 1999, Laughlin et al. 2006, Abella et al. 2011).

Tree Density and Distribution

Historical tree densities on reconstructed plots throughout the Southwest varied depending on factors such as elevation, aspect, slope, soils, moisture, and a site's unique history. An example of this was a reconstruction study involving 53 2.5-acre plots representing nine different ponderosa pine ecosystem types near Flagstaff, Arizona. Historical tree densities on these sites varied 19-fold, and averaged between 2 -40 trees per acre (Abella and Denton 2009). Moore's et al. (2004) reconstruction study on their 15 2.5 acre Woolsey plots estimated a mean density of 40 trees per acre based on live tree and cut-stump BA (Moore et al. 2004). On the same Woolsey plots, Sanchez Meador et al. (2010) found that the number of tree groups ranged from 4-11 per acre and ranged in size from 0.004 ac to 0.06 acre. Other reports of historical tree densities include 22 trees per acre near Walnut Canyon (Menzel and Covington 1990), 23 trees per acre at Bar-M-Canyon (Covington and Moore 1994), 24 trees per acre on the Gus Pearson Natural Area (GPNA) on the Fort Valley Experimental Forest (Mast et al. 1999), and 24 trees per acre at Camp Navajo (Fule etal. 1997). A 1938 forest inventory on the long Valley Experimental Forest (central Arizona) showed that 75 trees per acre were present prior to the cessation of frequent fire (between 1880 and 1900). Woolsey (1911) reported an average of 18 trees per acre (> 4 inches dbh) in northern Arizona in the early 20th century. Typical historical tree groups ranged from 0.1 to 0.75 acres in size and comprised 2 to 40+ trees per group (White 1985, Fule et al. 2003, Covington et al. 1997). Restoration studies on the Fort Valley Experimental Forest near Flagstaff, Arizona, showed an average of 23 trees per acre that were grouped into distinct 0.05- to 0.7-acre groups consisting of 2-40 trees (Covington et al. 1997).

Structural characteristics widely reported for historical Southwest ponderosa pine are relatively open forests with trees typically aggregated in small groups within a grass/forb/shrub matrix (Cooper 1960, White 1985, Pearson 1950, Covington et a1.1997, Abella and Denton 2009). Recent work in northern Arizona has shown that tree densities across nine different ponderosa pine ecosystems depended to a large extent on soil type and climatic variables such as minimum spring and fall temperatures, and May precipitation (Abella and Denton 2009). This work also showed that the degree to which trees were aggregated into groups was largely explained by ecosystem soil type. Twenty-eight to 74 percent of all trees were in groups; the remaining trees were scattered individuals (Abella and Denton 2009). These structural conditions were maintained by frequent low-intensity surface fires that more often killed small rather than large trees (Weaver 1951, Fiedler et al. 1996, Cooper 1960). Other small-scale disturbances such as insects, disease and others also shaped this characteristic forest structure. Low intensity fires occurred every 2 to 12 years and maintained an open canopy structure (Covington et al. 1997, Moir et al. 1997). The grass/forb/shrub understory and fine fuels (needles, cones, limbs) from large trees fueled these frequent fires started by lightning and, to an uncertain extent by Native Americans (Kaye and Swetnam 1999, Allen et al. 2002). Regular fire thinned or eliminated thickets of small trees, resulting in open, park-like forests (Cooper 1960, Covington et al. 1997, Allen et al. 2002).

While the ponderosa pine forest of northern Arizona have been widely studied and researched, the mixed conifer forest within northern Arizona have not been as widely studied or researched. However there are a growing number of studies within the mixed conifer forest across the southwest Colorado Plateau that provide historic reference conditions. The studies show a much wider variation in historic mixed conifer forest conditions compared to ponderosa pine. The two most relevant studies to this project were conducted on the San Francisco Peaks (Heinlein et. al. 2005 and Cocke et. al. 2005). The Heinlein study looked at two studies on the San Francisco Peaks between 7800 and 8800 feet. The study shows that the historical mixed conifer stands were dominated by ponderosa pine and tree densities averaged 21 trees per acre. The Cocke study also took place on the San Francisco Peaks between 8000 and 11700 feet; the mixed conifer portion of the study found historical conditions of 65 trees per acre.

Forest Openings and the Grass/Forb/Shrub Vegetation Matrix

Woolsey (1911) described late 19th century southwestern ponderosa pine forests as follows: "The typical western yellow (ponderosa) pine forest of the Southwest is a pure park-like stand(s) made up of scattered groups of from 2 to 20 trees, usually connected by scattering individual. Openings are frequent and vary in size. Because of the open character of the stand and the fire-resisting bark, often 3 inches thick, the actual loss in yellow (ponderosa) pine by fire is less than with other, more gregarious species."

Others also described historical ponderosa pine forests as having low tree density, open, savanna-like stands consisting of groups of pine trees interspersed with grassy or shrubby openings (White 1985). The actual degree of "openness" has received little measurement; instead, most reconstruction/restoration studies focused on tree densities and tree aggregation. Although White (1985) did not define how close trees had to be to constitute a "group" (he used the absence of 1919 regeneration beneath large tree crowns to define groups), he reported 22 percent of his plot on the GPNA was under tree groups. Thus, 78 percent of the 18 acre area would likely have been open before the 1919 regeneration pulse (White 1985). White (1985) reported that 12 percent of the historical trees on his plot were not in groups of three trees; if he had included single trees and groups of 2 trees, the percent open would have been less than 78 percent. Covington et al. (1997), also working on the GPNA, reported that while canopy cover was high within groups of trees, only 19 percent of the surface area of their study plot was under pine canopy; the balance (81 percent) represented grassy openings (Covington et al. 1997). Where crown cover was not reported, Gill's et al. (2000) mean crown radius for mature ponderosa pine (19.7 feet) can be used to estimate area under crowns. Of the 53 study plots in Abella and Denton (2009), those with only two trees had less than 2 percent under tree crown (98 percent open). At the opposite extreme, a plot with 40-trees had an estimated 28 percent under crowns (72 percent open). Using the same approach on the Long Valley Experiment Forest, for the 75 trees present before the cessation of fire (about 1900) resulted in about 52 percent of the per acre area under tree crowns (48 percent open). Sanchez Meador (Sanchez Meador et al. 2011 found a similar range between 10 and 30 percent on reconstructed Woolsey plots located throughout Arizona and New Mexico.

Sustainability and Resilience
Knowledge of the historical forest composition and structure on a site can provide estimates of forest composition, structure and pattern that was resilient to disturbance agents (insects, fire) and sustainable through at least several generations of trees (Allen et al. 2002, Abella et al. 2011). It may not be necessary, or even desirable in some cases, to have desired conditions that are within the natural range of variability at every site in southwestern forests and woodlands. However, historical conditions are more synchronous with the natural disturbance regime to which the forest and woodland ecosystems are adapted. Social, political and economic factors are much different today than a century ago and there are valid considerations for leaving areas of higher or lower tree-density or differing composition to meet resource management needs. But restoration on some portion of the landscape to conditions reminiscent of pre-European settlement times would most likely provide for greater biodiversity, and greater ecosystem productivity, stability, sustainability, resiliency and services.

General

A variety of forest conditions (composition, structure and pattern) would exist across the landscape, comparable to historic conditions. Forested landscapes would be diverse with groups and patches of variable tree densities, including groups with dense, closed canopies (interlocking crowns) and small areas of scattered individual trees; well shaded soil beneath tree groups; dead, deformed and diseased trees; large logs and woody debris; and old, large oaks, junipers and aspen. Canopy openings within the forest would be common and support a diverse species composition and productive grass/forb/shrub community. Forest habitats would contain a forest overstory dominated by ponderosa pine, mixed where appropriate with pinyon and juniper species, oaks, aspen, Douglas fir, limber pine or white fir. Large old alligator junipers would continue to exist where they currently occur.

Overall, the project area would be comprised of forest conditions that are resilient to disturbance (insects, disease, fire, climate change) and sustainable through at least several generations of trees. Forest habitats would generally be vigorous, with endemic levels of native insect and disease occurrences. Dwarf mistletoe would be an element of the forest landscape. There would be a varied level of mistletoe across the landscape, comparable to historic conditions. Forest structure and density would impede spread and reduces impacts associated with infection. Desired stand dwarf mistletoe infection levels would not exceed 20 percent infection of the host species (trees per acre basis), or 25 percent of the area infected for any given tree species (Conklin and Fairweather 2010). Dwarf mistletoe infections would be irregularly distributed among tree groups, such that effects are limited to the forest group and patch scale.

The ponderosa pine and dry mixed conifer forest would contain uneven-aged stands composed of a distribution of age classes that comprise a sustainable balance of structural stages. Old trees and old forest structure would be sustained over time across the landscape. In dry mixed conifer areas outside of MSO PACs and nest roost recovery habitats, basal areas would average less than 80 ft^2/acre. In wet mixed conifer areas, forests would be uneven-aged, with diverse species composition is maintained by large and small scale disturbances, and early seral species would be well represented.

Fully stocked, healthy forest conditions would facilitate capacity to store carbon and minimize tree losses to wildfires, insects, and diseases. Forests within the project area would provide a sustainable supply of diverse uses and values while contributing to the stabilization of carbon released into the atmosphere.

Ponderosa Pine

*Ponderosa Pine Goshawk Habitat Fuels Reduction within LOPFA Areas**

Desired future conditions include increased diversity in age and size classes, uneven-aged stand structure, and improved successional dynamics. Distribution of vegetative structural stages (VSS) is: 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), and 20 percent old forest (VSS 6).

Desired future conditions for the LOPFA areas include groups of 2 to 40 trees ranging in size from 0.1 acre to .7 acre, with openings between groups. Canopy cover within VSS 4-5-6 groups would vary from 40 percent to 70 percent. At the group level, basal areas would average 50 ft^2 per acre or greater in VSS 4, 5 and 6 groups. Stand density indices would be below 35 percent of SDImax over the majority of the area.

All yellow pines would be retained. All snags greater than 12 inches diameter would be retained, 3 downed logs greater than 12 inches diameter and at least 8 ft long, and 5-7 tons of woody debris greater than 3 inches in diameter would be retained per acre. Regeneration openings from 0.1 to 4 acres would be created across 20 percent of each stand. Regeneration openings up to 4 acres with a maximum width of 200 feet may be created; however openings should rarely be greater than two acres and the average opening size is approximately one acre. Regeneration openings would comprise up to 20 percent of each stand. Three to five trees per acres would remain in openings greater than one acre.

Ponderosa Pine Fuels Reduction within Northern Goshawk Post Fledging Areas (PFA)

Desired future conditions include increased diversity in age and size classes, uneven-aged stand structure, and improved successional dynamics. Distribution of vegetative structural stages (VSS) is: 10 percent grass/forb/shrub (VSS 1), 10 percent seedling-sapling (VSS 2), 20 percent young forest (VSS 3), 20 percent mid-aged forest (VSS 4), 20 percent mature forest (VSS 5), and 20 percent old forest (VSS 6). Tree groups in VSS 4 would average 1/3 60 percent and 2/3 50 percent canopy cover.

Desired future conditions for PFAs include groups of 2 to 40 trees ranging in size from 0.1 acre to .7 acre, with openings between groups. Canopy cover within VSS 4-5-6 groups would vary from 40 percent to 70 percent. At the group level, basal areas would average 70 ft^2 per acre or greater in VSS 4, 5 and 6 groups. Stand density indices would be below 35 percent of SDI max over the majority of the area.

All yellow pines would be retained except where necessary for harvesting operations (e.g. in cable logging corridors). All snags greater than 12 inches diameter would be retained, 3 downed logs greater than 12 inches diameter and at least 8 ft long, and 5-7 tons of woody debris greater than 3 inches in diameter would be retained per acre. Regeneration openings up to 2 acres with a maximum width of 200 feet may be created; however openings should rarely be greater than two acres and the average opening size is approximately one acre. Regeneration openings to establish new or release existing VSS 1 and 2 would comprise up to 20 percent of each stand. Three to five trees per acres would be retained in openings greater than one acre.

Ponderosa Pine Fuels Reduction within Northern Goshawk Post Fledging Nest Areas

Desired future conditions include mature to old age trees with high canopy cover. Canopy cover averages approximately 60 percent across VSS 4, 5 and 6 tree groups. All snags greater than 12 inches diameter would be retained, 3 downed logs greater than 12 inches diameter and at least 8 ft long, and 5-7 tons of woody debris greater than 3 inches in diameter would be retained per acre. No openings would be created and treatments would emphasize retention of large trees. Retain and promote large trees. Within the northern goshawk nest area, desired future conditions include non-uniform tree spacing and increased tree growth to progress VSS 4 to VSS 5 and 6.

Canopy cover was assessed at the stand level to meet the Forest plan standards and guidelines; Forest Plan standards for canopy cover apply to VSS 4, 5, and 6 within ponderosa pine. Canopy cover is averaged across the stand. Standards vary within and outside of northern goshawk PFAs and within goshawk nesting areas.

Ponderosa Pine within MSO Protected Activity Centers (PACs)

Desired future conditions for stands of ponderosa pine inside MSO PACs is to achieve old growth structural attributes as specified in the revised MSO Recovery Plan (USDI FWS 2012) and to reduce the potential for high intensity wildfire from burning up the PAC by reducing the fuels hazard. The desired conditions listed in the recovery plan call for a diversity of patch sizes with a minimum patch size of 2.5 acres, horizontal and vertical heterogeneity within patches, maintain or increase species diversity, create openings up to 2.5 acres in size, maintain canopy cover of 40 percent, and maintain 50 percent of basal area in trees greater than 16 inches dbh. Treatments would retain all trees greater than 18 inches dbh, woody debris larger than 12 inches in diameter, retain all snags, and all hard wood trees.

Forest Structure

Desired future conditions within the ponderosa pine cover types include: a more “open” forest structure that is sustainable, uneven-aged, and within the historic range of natural variability. Trees would be arranged primarily in “groups” of varying shape, size, and number of trees, with a mosaic pattern of individual and clustered trees interspersed among openings. The project area would exhibit an increase in age class diversity, decreased canopy cover, improved successional dynamics, increased and unsuppressed regeneration, increased old-growth forest, and increased vertical and horizontal heterogeneity (within stands and across the project area) compared to existing conditions.

Mixed Conifer

Dry Mixed Conifer Fuels Reduction

Desired future conditions within the conifer cover types include: a more "open" forest structure that is sustainable, uneven-aged, and within the historic range of natural variability. Trees would be arranged primarily in "groups" of varying shape, size, and number of trees, with a mosaic pattern of individual and clustered trees interspersed among openings. The project area would maintain age class diversity, decrease canopy cover, improve successional dynamics, increase unsuppressed regeneration, increase old-growth forest, and maintain or increase vertical and horizontal heterogeneity.

Regeneration openings up to 2 acres with a maximum width of 200 feet may be created; however openings are rarely greater than two acres and the average opening size is approximately one acre. Three to five trees per acres would be retained in openings greater than one acre.

All yellow pines and mixed conifer trees with fire scars would be retained. All snags greater than 18 inches diameter would be retained, 5 down logs greater than 12 inches diameter and at least 8 ft long, and 10-15 tons of woody debris greater than 3 inches in diameter would be retained per acre.

Dry Mixed Conifer Fuels Reduction within MSO Protected Activity Centers

Desired future conditions for stands of mixed conifer inside MSO PACs is to achieve old growth structural attributes as specified in the revised MSO Recovery Plan and to reduce the potential for high intensity wildfire from burning up the PAC by reducing the fuels hazard. The desired conditions listed in the recovery plan call for a diversity of patch sizes with a minimum patch size of 2.5 acres, horizontal and vertical heterogeneity within patches, maintain or increase species diversity, create openings up to 2.5 acres in size, maintain canopy cover of 60 percent, and maintain 50 percent of basal area in trees greater than 16 inches DBH. Treatments would retain trees greater than 18 inches dbh, yellow pines, mixed conifer trees with fire scars, snags greater than 18 inches, down logs greater than 12 inches mid-point diameter, and large hardwoods.

Exceptions would be made in the cable yarding treatment units for the cutting of large trees, and oaks to create cable corridors and falling of snags for safety purposes, and within the helicopter harvest units for the falling of snags for safety purposes.

Wet Mixed Conifer within MSO Protected Activity Centers

Desired future conditions for wet mixed conifer is to maintain a sustainable uneven-age structure perpetuated by small scale natural disturbance events. Effects from a wildfire would be moderate with mixed severity burns. The percentage of area in early seral stages is well represented. Small openings allow for the establishment of early seral species, such as aspen, pine, and Douglas-fir across the forest type. Large hardwoods, oak and maple, are maintained and are successfully regenerating.

Dry Mixed Conifer MSO Recovery Habitat

Within MSO recovery habitat, desired conditions include treatments that mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes. Stand structure should be uneven-aged. Treatments would emphasize the retention of trees greater than 24 inches dbh, yellow pines, mixed conifer trees with fire scars, snags greater than 18 inches, down logs greater than 12 inches mid-point diameter, and large hardwoods.

Dry Mixed Conifer MSO Nest Roost Recovery Habitat

Within MSO recovery habitat, desired conditions include a minimum average basal area of 120 ft^2 per acre. Trees from 12-18 inches dbh would comprise thirty percent of stand basal area and an additional 30 percent of basal area would come from trees greater than 18 inches dbh. The desired conditions for nest roost recovery also call for a diversity of patch sizes with a minimum patch size of 2.5 acres, horizontal and vertical heterogeneity within patches, maintain or increase species diversity, create openings up to 2.5 acres in size, maintain canopy cover of 60 percent. Desired conditions include treatments that mimic natural disturbance patterns by incorporating natural variation, such as irregular tree spacing and various patch sizes. Stand structure should be uneven-aged. Treatments would not remove trees greater than 18 inches dbh, yellow pines, mixed conifer trees with fire scars, snags greater than 18 inches, down logs greater than 12 inches mid-point diameter, and large hardwoods.

Aspen

Desired future conditions within the aspen cover type include: retention of aspen across in existing stands, increased regeneration, protection of regeneration from ungulate browsing, decreased conifer density and competition within aspen clones, and improved health, vigor, longevity, and sustainability of aspen clones.

Grasslands

The desired condition for mountain grasslands is to be relatively free of conifer encroachment, and to maintain a healthy and vigorous herbaceous production that allows for periodic and regular fire return intervals, which would also prevent conifer encroachment.

Old Growth

Desired conditions for old growth are to allocate a minimum of 20 percent of the forested landscape for managing toward old-growth conditions. Desired conditions for all stands of ponderosa pine and mixed conifer which fall inside designated MSO PACs, and in northern goshawk nest areas is to achieve old growth structural attributes as specified in the Forest Plan.

Forest Health

Desired future conditions across the project area include improved tree health and vigor, improved forest health, and a sustainable forest structure that is more resilient to the effects of climate change, including high-severity wildfire, insects and diseases.

Dwarf mistletoe is an element of the forest landscape. There is a varied level of mistletoe across the landscape, comparable with historic conditions such that it does not impede achieving and sustaining desired uneven-aged forest conditions. Desired stand dwarf mistletoe infection levels do not exceed 20 percent infection of the host species (trees per acre basis), or 25 percent of the area infected for any given tree species (Conklin and Fairweather 2010). Dwarf mistletoe infections are irregularly distributed among tree groups, such that effects are limited to the forest group and patch scale.

Desired future conditions for understory vegetation include increased diversity, productivity, and abundance of understory species.

Need for Change

Ponderosa Pine

In general across northern goshawk habitat, there is a need to decrease canopy cover and create a more variable and patchy tree distribution. There is a need to decrease the percent of the project area in "closed" canopy conditions within VSS 3, 4, 5, and 6 groups. There is also a need to create a more variable, patchy tree distribution across the project area. There is a need to decrease stand densities in the majority of the ponderosa pine and mixed conifer forest within the project area. There is a need to reduce tree densities across northern goshawk nest areas and create non-uniform tree spacing.

Vegetative Structural Stage (VSS)

The desired VSS distribution for the northern goshawk according to the Forest Plan, in comparison with existing conditions and the resultant gap, is displayed in Table 9. VSS guidelines apply only to pine stands located outside of MSO habitat. In order to obtain desired future conditions, there is a need to decrease the proportion of the ponderosa pine in young and mid-aged forest by approximately 43 percent. VSS 1 and 2 are severely lacking across the project area or occur in small amounts. Thus, there is a need to create up to 20 percent openings across the forested ponderosa pine stands within the project area to increase and promote existing natural regeneration, thereby increasing VSS1 and VSS2. Additionally, there is a need to increase the proportion of the project area in mature to old forest by approximately 22 percent.

Currently approximately 100 percent of goshawk nest areas within the ponderosa pine are VSS 4. There is a need to manage nest stands to help move the nests stands to the desired VSS 5 and 6 classes.

Table 9: Desired Vegetative Structural Stage (VSS) distribution for the northern goshawk, according to the Forest Plan, for DLH (ponderosa pine)

VSS DISTRIBUTION	VSS 1	VSS 2	VSS 3	VSS 4	VSS 5	VSS 6
DESIRED FUTURE CONDITIONS	10%	10%	20%	20%	20%	20%
EXISTING CONDITIONS:	0	0	39	44	7	11
NEED FOR CHANGE	+10%	+10%	-19%	-24%	+13%	+9%

Dry Mixed Conifer

There is a need to reduce overall stand density in the majority of mixed conifer stands. There is a need to reduce the threat of high intensity wildfire in mixed conifer stands within the MSO PACs. There is a need to reduce fire hazard to "low" or "moderate" and to create conditions conducive to the reintroduction of low-intensity prescribed fire. There is a need to create a leave tree arrangement that would result in decreased inter-tree competition, increased tree health and vigor, reduced fire hazard, and increased size class diversity

There is a need to reduce canopy cover on the 76 percent of mixed conifer areas where canopy cover exceeds 60 percent. There is a need to reduce SDI in mixed conifer areas where SDI is greater than 35 percent of max SDI. Three is a need to reintroduce periodic low intensity fires.

Wet Mixed Conifer

There is a need to minimize the amount of high burn severity that would occur if the wet mixed conifer areas were to burn in a wildfire. There is a need to reduce the current fuel loading. There is a need to increase the percentage of early seral species the wet mixed conifer by creating openings across 10 percent of the area. There is a need to protect aspen and maple regeneration from ungulate browsing by jackstrawing or fencing.

Aspen

There is a need for increased regeneration, protection of regeneration from ungulate browsing, decreased conifer density and competition within aspen clones, and improved health, vigor, longevity, and sustainability of aspen clones. There is a need to remove conifer encroachment across 22 acres of identified aspen stands and within pockets of aspen that occur within ponderosa pine and mixed conifer stands. There is a need to protect aspen regeneration from ungulate browse by either jackstrawing or fencing.

Grasslands

There is a need to restore identified mountain grasslands. There is a need to remove encroachment to the known historic extent and to restore frequent fire return interval.

Old Growth

There is a need to increase the amount of area allocated to be managed toward old-growth desired conditions in the ponderosa pine cover type forest in the MM area by a minimum of 332 acres. There is a need to designate and manage to develop old growth all stands within MSO PACs and goshawk nest stands that do not currently meet existing old growth conditions. Those stands would need to be managed to achieve old growth conditions over the long term.

Forest Health

There is a need to decrease stand densities below critical thresholds for increased risk of bark beetle attack and mortality. There is a need to reduce fire hazard to “low” or “moderate” and to create conditions conducive to the reintroduction of low-intensity prescribed fire. There is a need to create a tree arrangement that would result in reduced fire hazard; decreased inter-tree competition; increased tree health, vigor, and resiliency to the effects of climate change; and increased size class diversity.

Soil and Water Resources

The description of existing conditions of soil resources, including limitations associated with their management and land use activities, relies largely on information published in the Coconino National Forest (CNF), Terrestrial Ecosystem Survey (TES) (Miller, et. al. 1995). The Soils & Hydrology Specialist Report includes more information about existing conditions, including background on TES and watershed condition framework.

Existing Conditions

Soil Condition

A soil condition category is assigned to each TES map component either through Universal Soil Loss Equation (USLE) predictions regarding long-term annual soil loss or using the soil quality (condition) assessment and rating protocol developed for Region 3 of the Forest Service (USDA Forest Service, File 2550). Soil condition ratings are based on interpretations of the three primary soil functions: soil hydrologic function, soil stability and nutrient cycling. In general, hydrologic function of the soil is assessed based on indications of reduced infiltration through compaction and modification of surface soil structure.

Soil condition classes used are Satisfactory, Impaired, and Unsatisfactory. The entire DLH portion of the project area is within the Satisfactory soil condition class. Roughly 98 percent of MM is also in the Satisfactory soil condition class; the remaining acres are listed as Impaired, due to those areas having less vegetative ground cover than identified in the TES reference conditions for possible reasons ranging from conifer encroachment to grazing by domestic and wild ungulates. The satisfactory condition of soils in the analysis area is generally attributed to high amounts of vegetative ground cover, including vegetation basal area and litter, which serves to protect the soil from raindrop impact and dissipate the energy of overland flow. Despite this overall rating, nutrient cycling within ponderosa pine and mixed conifer vegetation types has been observed to be less than satisfactory as a result of low understory species diversity. This low diversity of understory species is typically the result of a dense overstory canopy cover that limits growth of herbaceous plants.

Soil burn severity has been identified as a key indicator of the susceptibility of a burned area to accelerated erosion and flooding and, consequently, soil burn severity categories are used to determine appropriate soil and hydrologic parameters needed for post-fire runoff and erosion modeling (see the Soil and Water Resources Methodology section for more information about the modeling). More analysis of soil burn severity is included in the Soil and Water Resources section (within the No Action Alternative analysis) of Chapter 3.

Erosion Hazard Rating

TES defines erosion hazard as the probability of soil loss resulting from the complete removal of vegetation and litter. It is determined though a comparison of the potential soil loss rate for a map unit component as calculated using USLE to the estimated tolerance soil loss rate for a map unit component. A slight rating indicates that all vegetative ground cover could be removed from the site and the resulting soil loss will not exceed "tolerance" soil loss rates. A moderate rate indicates that predicted rates of soil loss will result in a reduction of site productivity *if left unchecked*. Conditions in moderate erosion hazard sites are such that reasonable and economically feasible design features can be applied to reduce or eliminate soil loss. A severe rating indicates that predicted rates of soil loss have a high probability of reducing site productivity before mitigating measures can be applied. Erosion hazard ratings for soils within the DLH and MM analysis areas are shown in Figure 8 and Figure 9.

The majority of soils in map units associated with the DLH analysis area have low soil erodability factors; however, many of these same soils are assigned moderate to severe erosion hazard ratings. This can generally be explained by the steep slopes in the DLH area. Slope has a strong influence on erosion as reflected in USLE since runoff velocity is a function of slope gradient.

The majority of soils associated with TES map units in the MM analysis area have moderate soil erodability factors. Map units with severe erosion hazard ratings are often found on steep slopes.

Figure 8: Erosion Hazard Ratings within the DLH Analysis Area

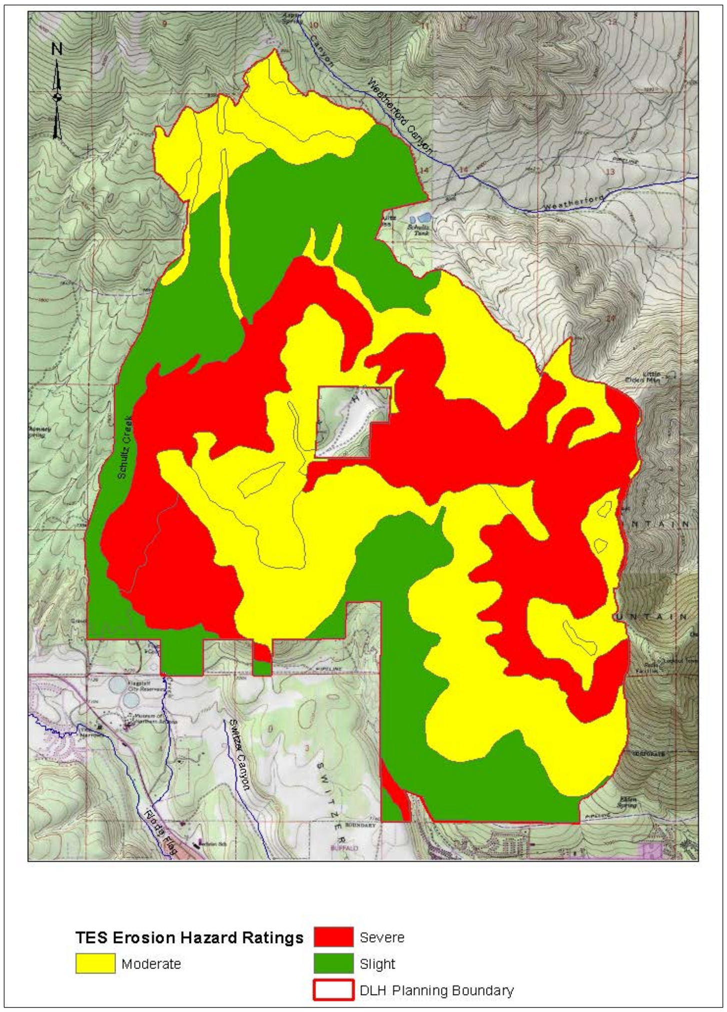
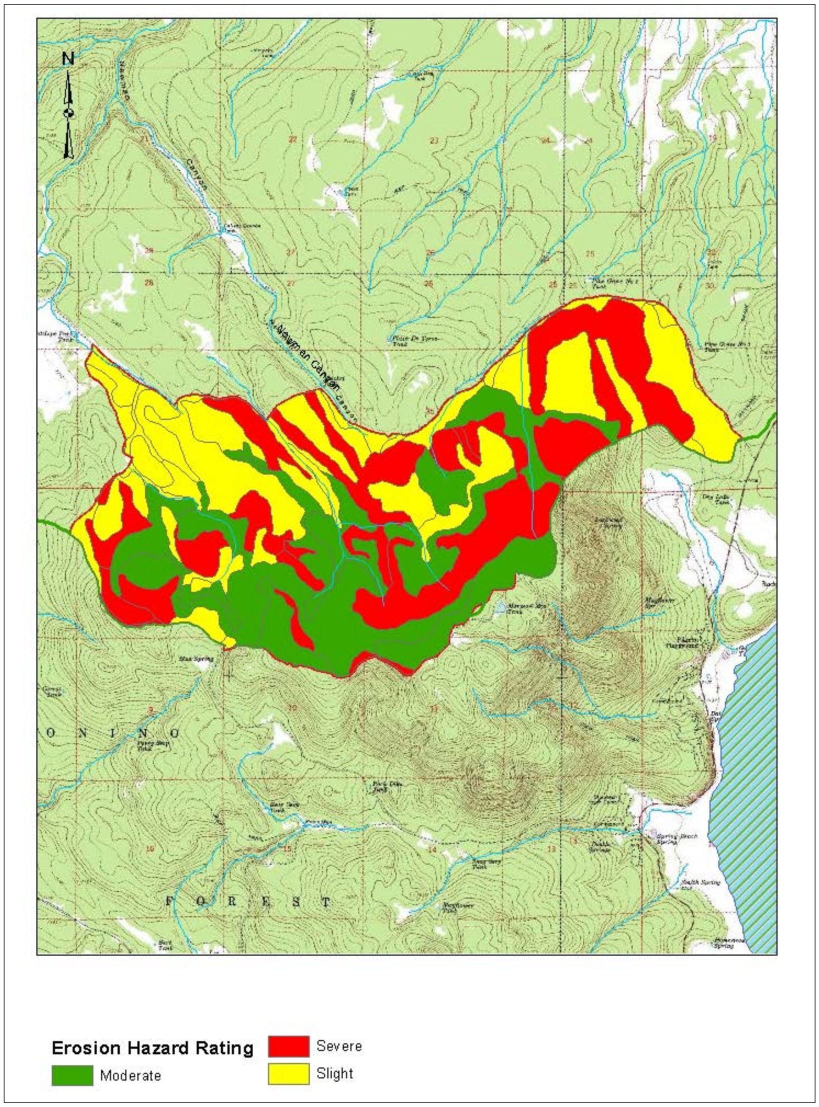


Figure 9: Erosion Hazard Ratings within the Mormon Mountain Analysis Area



Hydrology: Watersheds and Streamcourses

The DLH analysis area occurs mostly within the Upper and Lower Rio De Flag subwatersheds with the analysis area's northeastern boundary roughly coincident with the western boundary of the Doney Park sub-watershed. All three of these sub-watersheds are in the larger Rio De Flag watershed, which drains to the Little Colorado River to the east. The analysis area is drained by two drainage areas tributary to the Rio De Flag; Schultz Creek and Spruce Avenue Wash as shown in Figure 10. The analysis area contains one feature mapped as a wetland by the National Wetlands Inventory (NWI), which is located in the DLH-portion of the project area and commonly known as "Dry Lake."

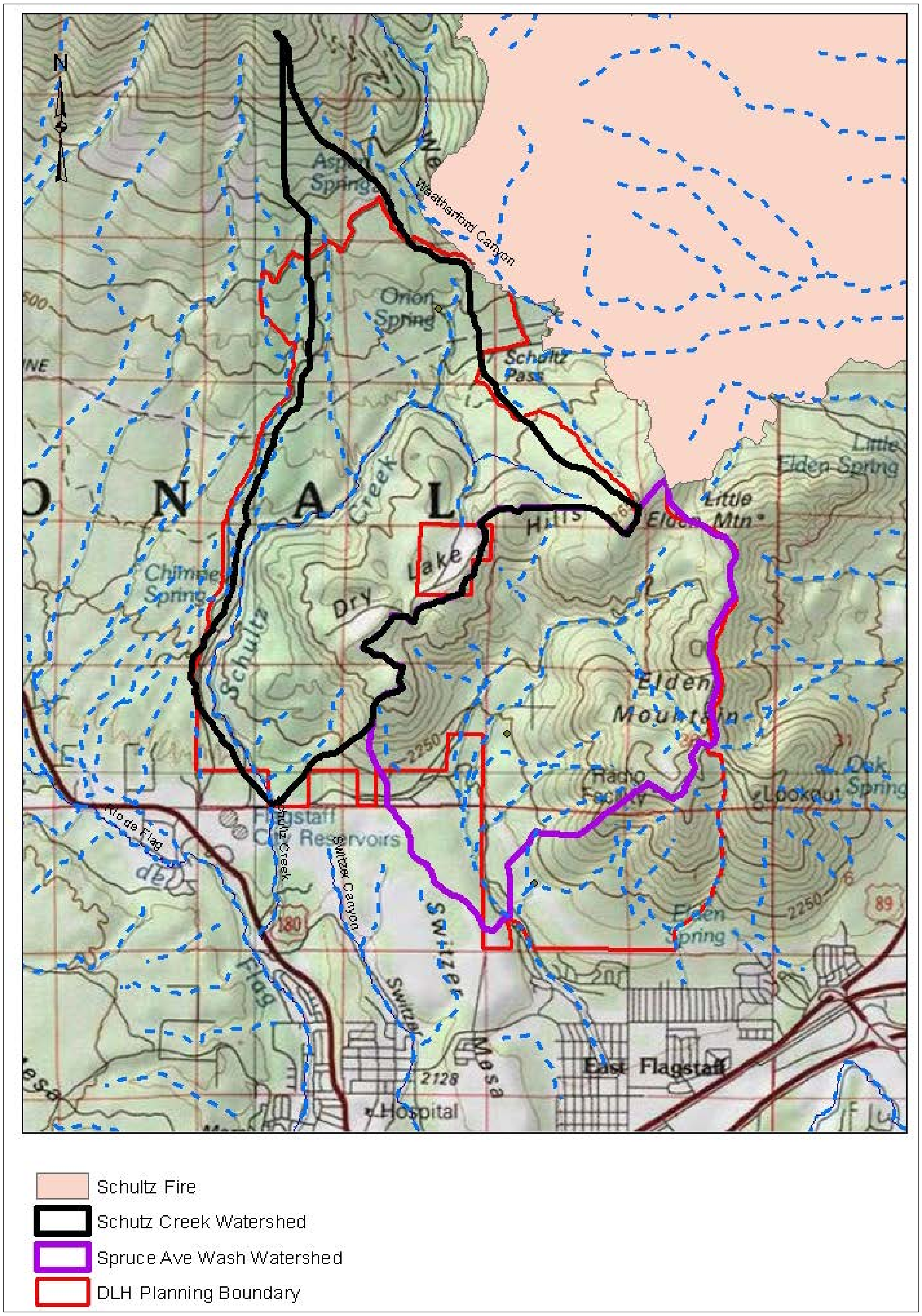
There are three mapped springs in the analysis area including Orion Spring and an unnamed spring in the DLH-portion of the project area, and Weimer Spring in in the MM-portion of the project area.

There are two main drainages in the DLH-portion of the project area; Schultz Creek and Spruce Avenue Wash. These drainages are both tributary to the Rio De Flag. Flow data for these drainages is limited to measurements of peak discharge as estimated using crest-stage gages installed and monitored as part of a USGS study of the flood hydrology in and around the City of Flagstaff (Hill, et.al., 1988). In six of eleven years of gage data, no discharge was recorded for the Schultz Creek drainage. In the eleven year period of record spanning from 1970 to 1980, the highest peak discharge of 48 cubic feet/second (CFS) was recorded in April 1973. The no or low annual peak discharge estimates for Schultz Creek are likely attributable to the mostly undeveloped nature of the Schultz Creek drainage basin combined with its high amount of vegetative ground cover, high infiltration rates of the associated forest soils, underlying geology, and its position relative to subsurface water-bearing zones. Schultz Creek is considered an ephemeral stream. There may, however, be portions of the roughly six mile long drainage with more persistent surface water as has been observed in the vicinity of the Schultz Creek and Sunset trail intersection where willows (Salix sp.) are present and surface water has been observed persisting into June, which is usually the driest month of the year.

As part of the same USGS study referenced above, annual peak discharge estimates for Spruce Avenue Wash (referred to as the Switzer Canyon Tributary by the USGS) were made from crest-stage gage measurements spanning a 12 year period of record beginning in 1968 and ending in 1980. Annual peak discharge estimates for this drainage ranged from a low of 15 CFS in December of 1971 to a high of 262 CFS in August of 1968. The USGS study concluded that most of the runoff in this drainage originated from the urbanized portion of the drainage basin. Although the amount of runoff generated in the undeveloped portion of the drainage basin occurring on Forest Service-managed lands was not determined, observations made where the Spruce Avenue Wash crosses Cedar Street indicated that runoff did not reach the urban part of the watershed and the highest peak discharge was estimated to be five CFS, presumably based on an observation of flow debris. The limited discharge from the un-urbanized portion of the Spruce Avenue Watershed is probably attributable to the same factors limiting flow in Schultz Creek and this drainage is also classified as ephemeral.

See the Soil/Hydrology Specialist Report for more information about ephemeral and intermittent surface water within the project area.

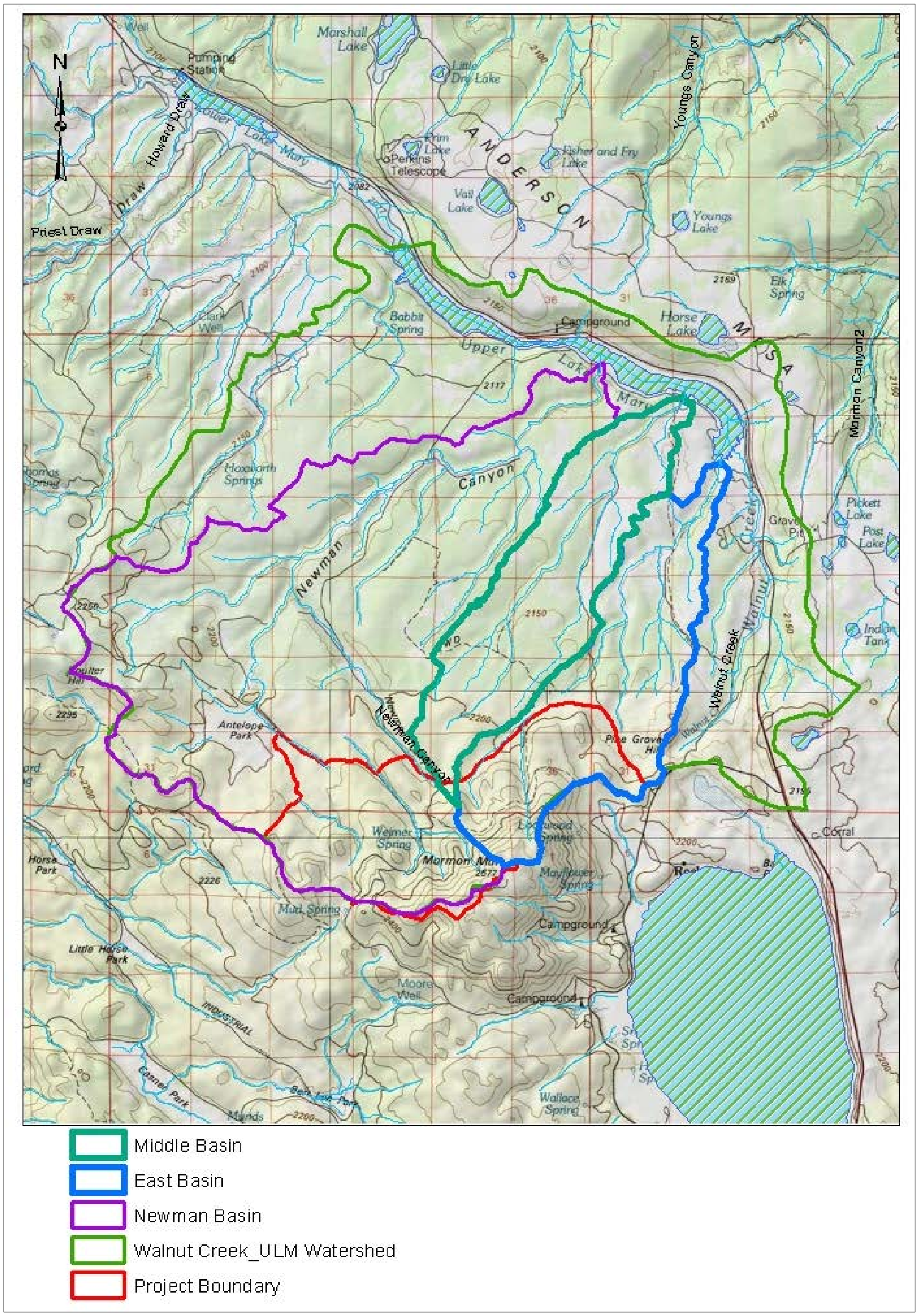
Figure 10: Streamcourses and Drainage Areas within the DLH Portion of the Analysis Area



The MM analysis area is almost entirely within the Walnut Creek-Upper Lake Mary (ULM) sub-watershed as shown in Figure 11. The flow of surface water to Upper Lake Mary, an important watershed for the drinking water of Flagstaff, is derived from the Walnut Creek – ULM sub-watershed. This sub-watershed is part of the Walnut Creek watershed which drains to the San Francisco wash, located east of Flagstaff, and eventually, to the Little Colorado River. Three drainage areas with outlets at Upper Lake Mary, informally referred to Newman basin, Middle basin, and East basin, drain the MM analysis area as shown in Figure 11.

There are two main streamcourses with headwaters in the MM-portion of the project area that enter Lake Mary as shown in Figure 11: Newman Canyon and an unnamed streamcourse. Roughly 44 percent of the project area (1300 acres) drains through Newman Canyon. Except for roughly 22 acres (less than one percent) of the project area that drains through Railroad Wash entering roughly the upper portion of Upper Lake Mary, surface flow from the remainder of the project area is directed through an unnamed drainage entering the upper end of Upper Lake Mary. No flow data exists for these drainages, but the size and elevation of the contributing watersheds suggest that these drainages may be intermittent flowing for extended periods during the spring from snow melt.

Figure 11: Streamcourses and Drainage Areas within the MM Area



As discussed in the Fire and Fuels section, approximately 88 percent (4,783 acres) of the DLH portion of the analysis area is in fire regime I, condition class 3 with most of the remaining area in fire regime III, condition class 3 (1,487 acres). Within the MM portion of the analysis area, approximately 89 percent (2,646 acres) is within fire regime I, condition class 3. This high departure from natural (reference) conditions highlights the vulnerability of the catchments draining the analysis area to a fire that would likely greatly alter the catchment hydrologic response, rate of erosion, and sediment transport (Neary, et.al., 2005).

Water Quality

There is limited water quality data available for streamcourses within or immediately downstream of the analysis area primarily because they are not perennial surface waters. Arizona Department of Environmental Quality's (ADEQ) most recent assessment of surface water quality included two streamcourses with their headwaters at roughly the northern boundary of the MM-portion of the analysis area: Newman Canyon and Railroad Wash (ADEQ, 2012). Both streamcourses were rated as "inconclusive" though no exceedances of state water quality standards were reported during the respective sampling periods. Both streamcourses were sampled near their inlets to Upper Lake Mary. ADEQ also assessed and rated as "inconclusive" a 3.7 mile reach of the Rio De Flag extending from the discharge outfall for the City of Flagstaff's Wildcat Hill wastewater treatment facility to San Francisco Wash. No exceedances of state water quality standards were reported during the sampling period. This reach is downstream of locations where Schultz Creek and Spruce Avenue Wash/Switzer Canyon enter the Rio De Flag.

In 2002, five lakes in what is referred to as the "Lake Mary Region" (LMR), including Upper Lake Mary, were listed as impaired for mercury in fish tissue. A TMDL study of the LMR lakes was completed in 2010 (ADEQ, 2012). Potential sources of mercury identified in the report included direct atmospheric deposition to the lakes, and input of sediment containing mercury from atmospheric deposition or existing naturally in soil parent material. In Upper Lake Mary, 81 percent of the average annual loading of mercury for a 10 year period was estimated to be from sediment input to the lake, whereas 19 percent was attributed to direct atmospheric deposition. It was further determined that most of the annual sediment loading was from transport by snowmelt though average mercury concentrations in runoff during August and November were more than twice average mercury concentrations in runoff during January through April, suggesting that rainfall has a bigger contribution than suggested by previous determinations.

Desired Conditions

The following desired conditions for soils and water resources are based on applicable state and Federal laws, Forest Service direction, and the professional judgment of the interdisciplinary team resource specialist.

- Critical soil functions and processes including the infiltration and storage of water, the cycling and storage of nutrients, and the maintenance of diverse populations of native soil microflora are enhanced or preserved. Management activities do not produce substantial and permanent impairment of land productivity.

- Water quality meets state standards for designated uses. Sediment inputs to stream courses do not contribute to impairment of stream courses or other water bodies.

- Susceptibility of soils and water resources to the potential negative consequences from an uncharacteristic wildfire are minimized.

Need for Change

The need for change for the soils and water resource area are closely tied to those described in the Fire Hazard Section above. In order to meet the desired conditions defined above, there is a need to reduce the potential for high severity wildfire in the project area to reduce the potential effects from fire on the forest soils and water resources.

Proposed Action Development & Refinement

The proposed action displayed here is the updated version of the proposed action published in April 2013, and represents many of the comments received during the scoping period and subsequent IDT meetings.

Proposed Action

In response to the purpose and need, the Coconino National Forest proposes to conduct thinning and burning activities within the approximately 10,544 acre project area using a variety of harvesting methods, analyzed in three action alternatives: Alternative2: Proposed Action with Cable Logging, Alternative 3: Proposed Action without Cable Logging, and Alternative 4: Minimal Treatment. Two Forest Plan amendments are proposed for all three of the action alternatives: Amendment 1 relates to treatments in Mexican spotted owl habitats, and Alternative 2 would authorize mechanized equipment use on slopes above 40 percent.

Chapter 2 displays proposed activities by alternative for comparison; more detailed information about each alternative, including design features, can be found in Chapter 2. In general, the proposed action would:

- Cut up to approximately 5,329 acres of mixed conifer stands, up to 3,240 acres of ponderosa pine stands, up to 22 acres of aspen stand, and 60 acres of grasslands. Trees cut would be piled, burned, lopped and scattered or removed.

- Cut trees up to 18 inches dbh on 3,141 acres within 10 MSO PACs, potentially during one but no more than two breeding seasons (see the Forest Plan Amendments section of Chapter 2).

- Cut trees up to 5 inches dbh within 80 percent of the Schultz Creek nest core (20 percent would be deferred). Conduct prescribed burning within all MSO nest cores. All activities within MSO nest cores would occur outside of the breeding season (see the Forest Plan Amendments section of Chapter 2).

- Conduct prescribed burning on up to 8,973 acres. Burning methods would include jackpot, pile burning and broadcast. Maintenance burns would occur every five to ten years in the ponderosa pine to maintain openings between trees, maintain tree groups and clumps, and move towards and/or maintain Fire Regime Condition Class (FRCC) I. Maintenance burning may not occur within the mixed conifer during the life of the project due to its historically higher fire return interval.

- Utilize (and reconstruct as needed) up to approximately 21 miles of existing closed roads and new temporary roads. Use of the roads would be temporary. Once treatment has occurred, roads would be returned to a closed status and/or decomissioned.

- Decommission up to 4.38 miles of select closed roads. Decommission methods would include installing signs, gates, rock barriers, ripping, or re-contouring of slopes to preclude future motorized use. Roads that have established vegetation may need minimal treatment while others may need to be entirely ripped, seeded and roadbeds re-contoured.

- Implement a permanent Campfire Closure Order in the Dry Lake Hills portion of the project area.

Design Criteria Integral to the Proposed Action by Resource

- Forest Plan requirements by resource which are required of all activities in the proposed action are located in Appendix C.

- Sampling surveys for heritage resources has already been completed within the project area and accepted by the State Historic Preservation Office. Additional surveys for any new disturbance areas, including temporary road locations, would be conducted prior to implementation.

- The project-specific MSO monitoring plan would be finalized through consultation with the Fish and Wildlife Service prior to implementation.

- Treatments would be designed to manage for old age trees in order to have and sustain as much old forest structure as possible across the landscape.

Relationship to the Forest Plan

This EIS is a project-level analysis; its scope is confined to addressing key issues and possible environmental consequences of the project.

The Coconino Land and Resource Management Plan (hereafter referred to as the “Forest Plan”) sets forth in detail the direction for managing the land and resources of the forest. The desired conditions for the project are based on Forest Plan objectives, goals, standards and guidelines. As appropriate, the desired conditions also reflect the language from the draft forest plan currently underway. The analysis also tiers to the forest’s Final Environmental Impact Statements (USDA Forest Service 1987) as encouraged by 40 CFR 1502.20. All three action alternatives would include two site-specific amendments to the 1987 Forest Plan related to MSO treatments and use of mechanical equipment on slopes greater than 40 percent. See Chapter 2 and Appendix A for more information.

Management Direction

The project area includes 11 Management Areas (MA) as described in the Coconino NF forest plan (pp. 46 to 206-113). An additional 40 acres is classified as private lands which were formerly private but are now Forest Service land. In the Dry Lake Hills part of the project the Schultz management area (MA-36) overlays most of the project area. In the Mormon Mountain part of the project the Lake Mary Watershed Management Area (MA-35) also overlays most of this part of the project area.

Table 10 summarizes applicable forest plan direction by Management Area (MA) for those management and geographic areas where fuels reduction actions are proposed. Chapter 4 of the Forest Plan (pp. 21 to 206-118) has detailed descriptions of forest-wide resource direction specific to the management/geographic areas. How the alternatives are consistent with the Forest Plan is discussed in Chapter 2, Alternatives, and in Appendix C.

Table 10: Forest Plan Management and Geographic Areas, Acres within Project Area

Forest Plan Management Area/ Geographic Area	Management Area/Geographic Area Description	Acres of Management Area/Geographic Area in Project Area
MA -3	Ponderosa pine and mixed conifer on less than 40 percent slopes	5,509 acres
MA -4	Ponderosa pine and mixed conifer on greater than 40 percent slopes	3,734 acres
MA -5	Aspen (MA-08)	91 acres
MA -6	Unproductive Timber Land	672 acres
MA-8	Pinon-Juniper Woodlands, greater than 40 percent slope	15 acres
MA-9	Mountain Grasslands	46 acres
MA-10	Grasslands and sparse Pinyon-Juniper Above the Rim	140 acres
MA-18	Elden Environmental Study Area	278 acres
Electronic Sites		28 acres

Decision Framework

Given the purpose and need of the project, the Coconino Forest Supervisor will review the proposed action, other alternatives and the environmental consequences in order to decide whether or not, and in what manner, lands within the Flagstaff Watershed Protection project area would be treated to reduce wildfire and flooding hazards. The decision will be based on a consideration of the environmental effects of implementing the proposed action or alternatives.

Based upon the effects of the alternatives and public comment, the Forest Supervisor will decide the best method for treating within the project area, which could involve a blending of alternatives. This “blending” could mean that a portion of two or more alternatives are chosen to essentially create a new alternative, as long as that decision includes actions that are identified and the potential effects are disclosed through the analysis of at least one of the alternatives. The range of alternatives included in the DEIS seeks to cover every feasible treatment option so that the responsible official can compare effects of each before deciding.

Items in this decision will include:

- number of acres treated mechanically
- number of acres treated by hand thinning
- number of acres treated with prescribed fire
- treatments within the MSO recovery habitat
- treatments within MSO PACs and protected habitat
- treatments within northern goshawk habitat
- construction and rehabilitation of new temporary roads
- decommissioning of closed roads after implementation
- type of implementation method to be used
- issuance of a permanent campfire restriction order in the Dry Lake Hills
- project-specific Forest Plan amendments
- design features to protect forest resources of soil, water, scenery values, wildlife and habitat, and rare plants
- monitoring proposal for treatments in MSO habitat

Public Involvement

FWPP has been listed on the Coconino National Forest Schedule of Proposed Actions (SOPA) since January, 2013. Throughout the project’s proposal development and the scoping period, the FWPP interdisciplinary team (IDT) met with interested parties, agencies and Tribes, including the Arizona Department of Game and Fish, the United States Fish and Wildlife Service, the Ecological Restoration Institute of Northern Arizona University, and environmental groups to discuss the proposed action.

Scoping

The formal 30-day public scoping period began with the publication of the Notice of Intent (NOI) to prepare an Environmental Impact Statement in the Federal Register on April 11, 2013, and ended May 13, 2013. The NOI referenced the public open house for May 1, 2013 hosted by the Forest, and that the Greater Flagstaff Forests Partnership (GFFP) would be hosting meetings on behalf of the City of Flagstaff, with information about the external project website (www.flagstaffwatershedprotection.org).

Scoping letters, including a link to the proposed action on the Forest website, were sent as hard copies to 606 individuals, including permittees, property owners, and state and local agencies. Thirteen personalized letters to tribal contacts were mailed simultaneously, and included hard copies of maps and the proposed action. An additional 157 cover letters with links to more detailed project information were sent to email contacts. A press release was issued from the Coconino National Forest April 10, 2013, and a public open house on the proposed action was held on May 1 to provide more information on potential activities, funding sources, and collaboration with the city. Notices regarding the meetings were posted on the Coconino website and the Flagstaff Watershed Protection Project external website.

Approximately 19 people attended the public meeting. Throughout April 2013, the City of Flagstaff hosted three outreach meetings targeted at specific interest groups with Forest Service involvement, including one for recreation user groups, interest groups, and adjacent land owners in the Mount Elden area (respectively). An additional public meeting geared toward the primarily-seasonal residents of Mormon Lake was hosted by the Forest Service on August 24, 2013. Twenty residents attended the meeting, held at the Mormon Lake Fire Station, and primarily voiced concerns about dust abatement and ensuring Best Management Practices are followed during implementation.

Using the comments from the general public, other agencies, environmental groups and Tribes (see *Issues* section), the interdisciplinary team developed a list of issues to address.

Tribal Consultation

On February 14, 2013 the Forest sent a separate consultation letters providing information and seeking involvement and comments to 13 Tribes and Tribal Chapters including the Pueblo of Acoma, the Hualapai Tribe, the White Mountain Apache Tribe, the Fort McDowell Yavapai Nation, the Navajo Nation, the Yavapai-Apache Nation, the Hopi Tribe, the Tonto apache Tribe, the Pueblo of Zuni, the Yavapai Prescott Indian Tribe, the San Carlos Apache Tribe, the San Juan Southern Paiute Tribe, and the Havasupai Tribe, who all have historic ties and an interest in the Coconino National Forest. Two written responses were received and The San Carlos Apache Tribe responded with a thank you and deferral to the Yavapai-Apache Nation, and the Hopi Tribe asked for additional information on what the expected outcome of the proposals would be and invited project representatives to their next administrative meeting. IDT representatives met with the Hopi Tribe on March 21, 2013 and on February 12, 2014 in Kykotsmovi, AZ; the Navajo Nation on May 7, 2013 in Window Rock, AZ; the Cameron Chapter of the Navajo Nation on July 14, 2013 to discuss the project. Representatives are also scheduled to meet with the San Carlos Apache Tribe March 5, 2014 in Globe, AZ. A tribal consultation report can also be found in the FWPP project record.

Issues

During the scoping process for FWPP, the public and the IDT identified several issues. The Forest Service separated the issues into two groups: relevant and non-relevant issues. Relevant issues were defined as those directly or indirectly caused by implementing the proposed action. Non-relevant issues were identified as those: 1) outside the scope of the proposed action; 2) already decided by law, regulation, Forest Plan, or other higher level decision; 3) irrelevant to the decision to be made; or 4) conjectural and not supported by scientific or factual evidence. The

Council on Environmental Quality (CEQ) NEPA regulations explain this delineation in Sec. 1501.7, "…identify and eliminate from detailed study the issues which are not significant [relevant] or which have been covered by prior environmental review (Sec. 1506.3)…" A list of non-relevant issues and reasons regarding their categorization as non-relevant may be found in the project record.

Twenty-five submissions from the public were received, containing a total of 144 comments (see the Scoping Summary document in the project record). One comment brought forth from the Center for Biological Diversity requested the development of an action alternative that would retain the Large Tree Retention Strategy (LTRS) developed by the Four Forests Restoration Initiative (4FRI) in its entirety, and also brought forth the concept of strategic placement of treatments, which is discussed in Chapter 2 for all the action alternatives. Another comment from Wildearth Guardians requested an alternative that did not include any temporary road construction and used hand thinning only. Some of the comments resulted in the refinement of the proposed action, including development and/or modification of design features and clarification of statements. Two additional action alternatives would also developed and retained for further analysis.

As for relevant issues, the Forest Service identified the following issues during scoping:

1. Restoration versus Fire Hazard Reduction Issue: A common public concern voiced during scoping was the importance and sustainability of restoring ecosystems versus a purely fire-hazard reduction approach to treatment because there is concern that a fire-hazard reduction approach would result in unnecessarily departing from historical conditions that could be more sustainable long-term. This issue is addressed by providing clarification in the Silviculturist report of which treatments are restoration-focused and which are designed for fire hazard reduction, and why the focus may not be a strict return to historical conditions in every part of the project area. Chapter 2 contains a section titled "Restoration Versus Fire Hazard Reduction" which discusses the proposed treatment types and whether their focus is restoration or fire-hazard reduction (see Table 23). The Silviculture section in Chapter 3 contains more detailed information, summarized from the Silviculture Specialist Report, located in the project record.

2. Mixed Conifer Issue: Several comments included concerns about different aspects of treatments in mixed conifer including what was perceived to be a proposal to change the Fire Regime of mixed conifer areas, the potential for vegetation conversion, and the differences between wet and dry mixed conifer vegetation types and treatments. The Silviculturist and Fire/Fuels sections include discussions of the existing and desired conditions for the primary vegetation types in the project area, including but not limited to species composition, canopy cover, tree group size, basal area, trees per acre, and Fire Regime Condition Class, and a discussion of how each alternative affects those conditions. The Silviculture section also contains an explanation of desired tree group size and basis for those ranges, as well as an explanation of wet and dry mixed conifer characteristics and locations. The Fire and Fuels section analyzes the effects of the proposed treatments on Fire Regime Condition Class of mixed conifer vegetation.

   Several comments also voiced concerns over treatments proposed in mixed conifer vegetation types due to its relative rarity and importance to wildlife. The Silviculture section includes discussion and clarification of where dry and wet mixed conifer occurs and the ecological need to treat in those areas. The Silviculture section also discusses how treatments in those areas would differ from each other and from treatments proposed for ponderosa pine. The Wildlife section includes discussion of anticipated effects of mixed conifer treatments on wildlife, particularly those species dependent on the mixed conifer vegetation type.

3. Conservation of Large (16” dbh+) Trees Issue: some comments indicated that the Forest Service should adopt project-level restrictions to minimize the cutting of trees greater than 18 inches dbh. This issue is addressed in Alternatives 3 and 4 through a greater focus on the protection of large-diameter trees; in Alternative 3 by the absence of cable logging, and in Alternative 4 though a minimal treatment approach. The Silviculture section details the estimated number of large (16” dbh +) trees that would be retained post-treatment under each alternative. Additionally, design features to protect fire-scarred mixed conifer species, large oaks and alligator juniper were be added to the action alternatives.

4. Monitoring Issue: Several comments included concerns over the lack of monitoring for anything other than the Mexican spotted owl and thus the potential to not know the effects of treatments on other wildlife and habitats. While the Mexican spotted owl includes an additional species-specific monitoring program, monitoring of treatment implementation, treatment effectiveness, and of wildlife habitat will occur. Specialists identified any required and/or supplemental monitoring that would occur in their resource areas as a part of this project, such as implementation and effectiveness monitoring. These monitoring requirements, as well as monitoring efforts proposed by outside organizations within the project area, detailed in Chapter 2 and Appendix B.

5. Snag Retention and Creation Issue: There is some concern over the loss of snags due to cable logging and also the effectiveness and viability of snags created through girdling and topping healthy trees compared to snags created through natural processes. This issue is addressed in Alternatives 3, which would not include cable logging harvesting methods and Alternative 4, which would treat a reduced area and thus restrict potential impacts on existing snags. Concerns about the viability of snag development are discussed in the Wildlife section of Chapter 3.

6. Prescribed Burning/Maintenance Issue: Public comments showed concern over proposed exclusion of prescribed burning in areas with mixed conifer on steep slopes due to the effectiveness and importance of prescribed fire. Concerns over whether maintenance burning would be included and what the intervals would be for the different fire regimes also arose during the scoping period. This has been addressed by revising the action alternatives to include prescribed burning over more of the project area, but with a different method proposed for wet mixed conifer. Maintenance burning was also included in the action alternatives with different return intervals proposed for ponderosa pine and mixed conifer. Chapter 2 and the Fire/Fuels section of Chapter 3describes how the proposed prescribed burning would be implemented for different vegetation types within the project area. The Fire/Fuels section also includes a discussion of the different Fire Regime Condition Classes (FRCCs) throughout the project area, and the goals and impacts of prescribed burning/maintenance burning within them.

7. Significance of Forest Plan Amendments Issue: The public voiced a concern about the significance of the proposed Forest Plan amendments included in one more of the alternatives due to the impact of these amendments on wildlife species including the northern goshawk and the Mexican spotted owl. This issue is addressed through the analyses of each Forest Plan amendment in each resource area and by the removal of the proposed amendment for canopy cover/interspaces; the latter was determined not to be necessary to meet the purpose and need of the project. Specialists included discussions of the effects of these amendments in their effects analyses, and the DEIS includes details on what would be amended in the Forest Plan and why.

8. Visual Effects Issue: The IDT identified a concern about potential impacts to scenic resources as a result of implementation due to the highly-valued view sheds contained within the project area. This concern is addressed through the development of Alternative 4, which includes a minimal treatment scenario. The Scenery Management section discusses effects to these resources and provides examples of what post-treatment conditions may look like under the different alternatives.

In addition to the issues identified above, a number of issues identified from public scoping were addressed through Design Features incorporated into one or more of the alternatives. The following topics were addressed through modification and/or creation of a design feature associated with the proposed action to address issues common to all action alternatives:

1. Residual slash treatment
2. Retention of old growth trees
3. Single-track trail protection
4. Fuelwood gathering area identification
5. Biomass utilization
6. No machine piling within 300 feet of residences
7. No hand piling within 50 feet of residences
8. Hunting access coordination with AZGFD
9. Dust abatement measures on Forest Roads during hauling activities

Publication of the Draft Environmental Impact Statement

On July 3, 2014 the draft environmental impact statement (DEIS) was released and the Federal Register published a notice of availability. This date began the 45-day comment period for public input. The DEIS included three action alternatives and the no action alternative. The DEIS summarized information from specialist reports on the potential effects of each alternative to fire and fuels, air quality, forest structure and health, soil and water resources, wildlife, scenery, economics, invasive plant species, sensitive plants, recreation and heritage. In anticipation of most people not having the time to read the entire DEIS, various shortened versions were provided, including a Reader's Guide and a Summary with Comparison Tables, pulled from Chapters 1 and 2 of the DEIS. Numerous outreach events were also held during the comment period, including two open houses (held July 17 and 22), two presentations and field visits with neighborhoods abutting the project area, a meeting with the Mormon Lake community, and meetings with special interest groups including Flagstaff Biking Organization and the Ecological Restoration Institute. In addition, information was disseminated through local media outlets, including KNAU and the Arizona Daily Sun. The FS Project Manager was also available for questions throughout the comment period, and offered to meet with interested individuals at their convenience (see email from August 11, 2014 in the Project Record). A Map Packet was made available on the Forest Service project website, along with copies of individual specialist reports, and an external website was developed in order for the public to more easily access information about the project (www.flagstaffwatershedprotection.org). Interactive Google Earth project maps were posted on the external website to allow the public to more easily determine locations of proposed treatments, temporary roads, and harvesting systems.

Response to DEIS, and Changes from Draft to Final

One hundred and seven submissions were received during the comment period on the DEIS; within those submissions, 530 individual comments were identified. Three main themes emerged from those comments:

1. Impacts from cable logging
    a. Erosion
    b. Unknown since it’s not common in southwest
    c. Visual
2. Implementation/Monitoring
    a. Forest Service oversight of contractor(s) (including marking, tree selection, and during harvesting)
    b. Monitoring tied to wildlife, treatment effectiveness, noxious weeds and soil impacts
    c. Maintenance (and how to finance)
3. Recreation
    a. Impacts to trails (system and non-system)
    b. Overlap with the Mount Elden/Dry Lake Hills Recreation Planning Project
    c. Area closures/safety concerns/duration during implementation
    d. Temp road to trail conversions
    e. Public outreach

The comments, interactions with the public and project partners, and discussions with the IDT resulted in modifications to the alternatives and updates to the analysis of potential effects. Responses were provided for each of those comments or concern areas in the extensive Response to Comments document, which is available online and in the project record. In addition to responding to comments, the IDT also updated the FEIS to reflect the modifications of alternatives and analyses. The main changes between the draft and final EISs include:

- Inclusion of a Socio-Economics section to address public comments related to project impacts on local economies and communities.

- Change in location of the temporary road proposed south of Mount Elden and north of the private property boundary.

- More detailed information in the Scenery section about cable logging examples both in the southwest and in other areas with similar ecosystems, such as eastern Montana.

- More pictures and descriptions of cable yarding systems within the Scenery section of Chapter 3.

- Updates to Appendix B - Monitoring Protocols:
  - Inclusion of Soil and Water Best Management Practices discussion
  - Update to Red Squirrel Monitoring Plan per Arizona Game and Fish Department
  - Update to MSO Monitoring Plan per Fish and Wildlife Service consultation
- Modifications to Design Features, including:
  - Adding a monitoring component to the snag creation design feature to aid in determining the effectiveness.
  - Adding a design feature to protect caves and karst, and sink holes.
  - Clarification on the protection of existing forest system trails during implementation
  - Addition of design features related to protection of MSO

In addition, an Implementation Plan has been developed to assist in communicating the steps necessary to implement a forest thinning project (e.g. timber preparation, contracting, contract oversight); how design features would be executed; and how the treatments would likely be phased.

Chapter 2. Alternatives

Introduction

This chapter describes and compares the alternatives considered for the Flagstaff Watershed Protection Project. It includes a description and map of each alternative considered. This section also presents the alternatives in comparative form, sharply defining the differences between each alternative and providing a clear basis for choice among options by the decision maker and the public. Some of the information used to compare the alternatives is based upon the design of the alternative (i.e., helicopter logging versus the use of skid trails) and some of the information is based upon the environmental, social and economic effects of implementing each alternative (i.e., the amount of erosion caused by helicopter logging versus skidding).

Action Alternatives: Strategic Placement of Treatments

The concept of strategically placing treatments across a landscape to modify fire growth and behavior at the landscape level has been proposed as a potential strategy for addressing implementation problems including limited funding, inadequate road access, variable land ownership and restrictions on prescribed fire and timber harvest (Finney 2001). Many studies have shown that strategic placement of treatments, especially intensive treatments, can reduce the risk of the spread of high-severity wildfire at the landscape level (Finney 2001, Suffling et al. 2008, Kim 2006, Ager et al. 2010)

The action alternatives focus treatment intensities on areas within the landscape that are highly vulnerable to high-severity wildfire. The project area includes areas on steep slopes with dense vegetation that have been identified as parts of the landscape most susceptible to post-fire impacts (because they are the most likely to result in downstream flooding), which means that the project itself is an attempt to strategically place treatments on the landscape by targeting those areas most likely to experience high-severity fire and those areas most susceptible to post-fire impacts.

In Alternatives 2 and 3, treatments are proposed for the majority of the project area, with more aggressive thinning treatments strategically proposed in areas at higher-risk of severe wildfire, including areas where topography aligns with the dominant winds. Areas within the project that present low fire hazard or contain uniquely limited habitats are proposed for less aggressive or no treatment. Alternative 4, in contrast, would include treatments only in those areas identified as having the highest potential for severe wildfire effects to soil resources as identified through fire and watershed modeling. The purpose for Alternative 4 is to provide an alternative that includes only the minimum amount of treatment necessary to meet the purpose and need; thus the proposed treatments would be more focused and less continuous across the project area.

Harvest Systems/Methods Descriptions

The following descriptions of harvesting systems, machinery and methods are described here to provide background and context to the proposed treatments and the associated effects analyses in Chapter 3. All of the systems/methods are analyzed for use, but the actual equipment used would depend on the final decision and also the contractor procured during implementation. The pictures are examples and are not necessarily representative of what would be used within the FWPP project area.

Conventional Ground Based: Conventional ground based harvest systems typically consist of several machines that all perform specialized functions. First a feller-buncher cuts the trees with a saw or shear head and then places them into bunches for subsequent removal. Wheeled fellers-bunchers, (Figure 12) are the dominant felling machines used in northern Arizona and operate well, up to approximately a 25 percent slope. Beyond 25 percent it is often necessary to use a tracked boomed feller-buncher (Figure 13) that has leveling capability and is capable of operating on steep slopes. These leveling feller-bunchers can work on up to 55 percent slopes but very rocky ground can limit their operation.

A rubber tired grapple skidder, (Figure 14) then drags whole trees that have been bunched by the feller-buncher, to a roadside landing area. At the landing, a processor, (Figure 15) removes limbs from trees and cuts them into log length. Finally, a loader (Figure 16) places logs onto a truck for transportation to a mill. Logging slash, (limbs and tops) generated at the landing can be burned on site or chipped and removed as biomass. Conventional ground based harvesting is generally limited to slopes of 40 percent or less due to capability limitations.

Figure 12: Wheeled feller-buncher used on slopes up to 25 percent

Figure 13: Tracked, boomed feller-buncher for steep slopes

Figure 14: Grapple Skidder

Figure 15: Log processer

Figure 16: Log Loader

Cut to length: The cut to length, (CTL) harvest system consists of a harvester, (Figure 17) that cuts trees with a bar saw and then, without releasing them from its cutting head, delimbs and processes them into logs. Limbs and tops are placed in front of the machine and are crushed down as the harvester moves ahead. A forwarder, (Figure 18) then follows in the harvester's trail and loads the cut logs into log bunks on the machine. These logs are carried above the ground service to a roadside landing. Repeated trips by the forwarder on the trail crush the slash into the ground.

If it is desirable to remove more of the slash, it is possible to only process the tree to the extent needed to get it on the forwarder. In some instances it may be possible to not process the tree at all and take it to the landing in tree length form. The stem then must be processed into logs at the landing.

In the past CTL has been limited to slopes of approximately 40 percent; however recent developments in technology now allow some models of harvesters and forwarders to operate on slopes of up to 65 percent slope for downhill forwarding and 45 percent uphill. Rocks that protrude from the ground over about 12 inches limit operability; however rocks that are embedded in the ground without a vertical side above ground do not impede operation greatly.

Figure 17: Harvester

Figure 18: Forwarder on 65% slope

Cable Logging (Skyline Yarding): Skyline yarding uses a system of cables, (Figure 20) to drag logs or whole trees from the cutting unit to a roadside landing. It is used on sites that are too steep for ground based operations.

A skyline yarder, (Figure 19) remains stationary on a road and supplies the power to operate the cables which pull in the harvested stems. The yarder also contains the drums on which the cables are stored. A tower on the yarder provides partial lift for the logs so that they better clear obstacles (e.g. topographical features, other vegetation, etc.).

A skyline is strung from the yarder and anchored to a tailhold at the bottom of the cutting unit. Roughly parallel "corridors" for the skyline needs to be placed every 100 to 140 feet. These corridors are approximately 12-feet wide and must have all trees removed from them to facilitate yarding. Logs are laterally yarded to this corridor and are then hauled up the skyline to the landing.

Trees can be mechanically cut if the ground conditions allow for feller-bunchers or harvesters to operate on it, otherwise felling is done by hand with chainsaws. Yarding is nearly always done uphill against gravity as this allows for the logs to remain under control of the yarder. Downhill yarding is very difficult in partial cuttings such as thinnings and requires a yarder with additional capability. Downhill yarding results in significantly greater stand damage and safety issues.

Skyline yarding is not limited by slope. If whole trees are yarded to the landing, a processor can manufacture the stem into logs just as in conventional ground based operations. A loader also loads the logs onto trucks for tranport.

Figure 19: Drawing of a skyline logging system, tops of the logs or trees usually drag on the ground

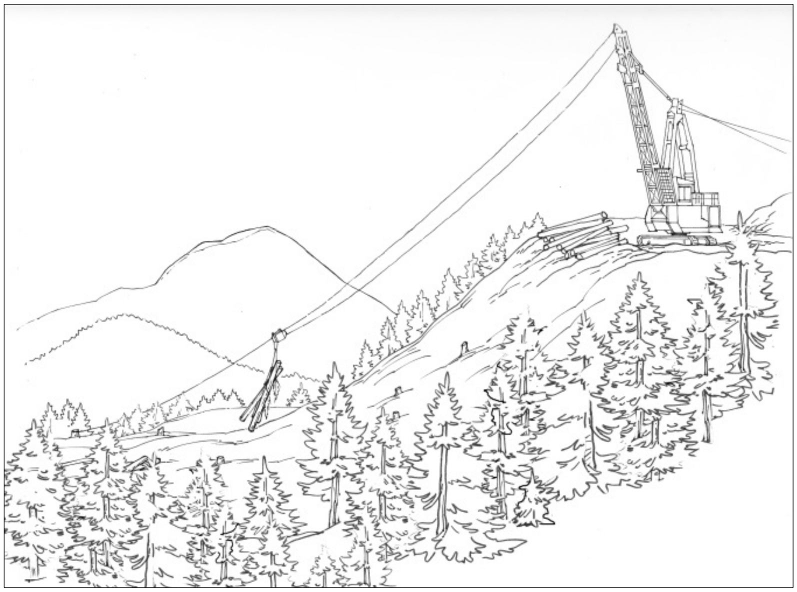


Figure 20: Skyline Yarder

A variation of skyline yarding involves a machine referred to as an Excaliner (Figure 21). Excaliners are excavators that have been converted for use as a skyline yarder. They are capable of operating off of constructed roads and yard timber up to the top of steep areas that a conventional yarder, which must remain on the road, would not be capable of accessing. Yarded timber is then skidded to a roadside landing with a rubber-tired skidder.

Figure 21: Excaliner yarding logs

A third type of cable yarding system is called a Jammer. Using this system there would be no defined corridor (skid trail) created up and down the slope, and no lateral yarding to a corridor. This system is portable and has a boom arm that “throws” a cable or tongs out as shown in Figure 25. The cables are connected to cut trees, and the whole cut trees are moved to an area where they are grouped and then branches and tops are removed. The Jammers can go off road and are well suited for shorter slopes of less than 300 feet. Since this equipment does not require a skyline or carriage, it can be moved around and set to avoid some of the large or old trees.

Figure 22: Jammer Yarding may be used on short, steep slopes (*Photo courtesy Tom Mahon Logging)*

Helicopter Yarding: Helicopter logging or yarding is a very simple logging method. Trees are felled either by hand or mechanically and then lifted free of the ground with a helicopter equipped with a 150-200-foot long line, (Figure 23) and flown to a roadside landing. Either logs or whole trees may be removed. However, flying whole trees with limbs and tops attached can significantly raise logging cost, as limbs and tops have little to no commercial value and are expensive to fly. Helicopter yarding is an extremely expensive method due to the high cost of operating a helicopter. If whole trees are flown, the tree is processed at the landing area with a processor.

Figure 23: Helicopter Yarding

Methods of Treating Fuels on Site without Extraction: Fuels can also be treated on site without being removed. Treating fuels on site could be carried out in areas where removing the material is not practical or desirable or in areas where the material being cut has little or no commercial value. Treating these fuels on site may be the most cost-effective method to achieve fuel reduction goals.

The most commonly employed method is to cut trees by hand, buck them to approximately 6-foot lengths and place this material into small piles, (Figure 24). Piles are then burned when weather and fuel moisture condition limit the fire's potential to spread beyond the pile. This method is simple, but it is also fairly expensive and labor intensive to implement.

Figure 24: Hand piles along Elden Lookout Road

On site piling can also be done mechanically with a feller-buncher or a harvester. A harvester is capable of cutting trees into any length desired and can create piles very similar to a hand constructed pile. Feller-bunchers however, are not designed to cut trees into logs and as a result can only place whole trees into long windrows for burning.

On very steep or rocky sites a steep slope excavator, commonly known as a “spider” may be used to treat fuels, (Figure 25). Spiders are designed to work in extremely difficult topography. While they are most often used as an excavator for piling or digging, they can be equipped with a harvester head and can cut, buck and pile standing trees. Their legs operate independently and they push themselves uphill with their boom. They can maneuver around and over fair sized boulders that would limit operations of other machines such as harvesters and feller-bunchers. They are a very specialized machine that is uncommon, especially in northern Arizona.

Figure 25: Spider piling slash on steep ground

Alternatives Considered in Detail

The Forest Service analyzed four alternatives in detail: the No Action (required by law as a baseline), the proposed action, and two alternatives to the proposed action in response to issues brought forth by the public.

Alternative 1: No Action Alternative

National Environmental Policy Act (NEPA) regulations require the no action alternative to be included as a baseline for comparison to all action alternatives. Under this alternative, no new areas treated in the FWPP area. Implementation of previous NEPA decisions, including Jack Smith Schultz and the Eastside Fuels Reduction and Forest Health Restoration projects could continue. For this Environmental Impact Statement, specialists analyzed the impacts of a modeled wildfire occurring under existing conditions (see the Fire & Fuels section of Chapter 3 for more information about the modeled wildfire).

Alternative 2: Proposed Action with Cable Logging Emphasis on Steep Slopes

Alternative 2 includes the updated proposed action (below) with an emphasis on the use of cable logging wherever plausible, as detailed in the Implementation Methods section.

Alternative 2 Treatment Summary

The FWPP project area includes approximately 10,544 acres; roughly 1,605 of those acres are either non-treatable due to rock faces and/or boulder fields, or are not slated to be analyzed in this project (see Figure 26). Treatments would include mechanical and hand thinning as well as prescribed fire on the remaining acres (approximately 8,938 acres).

Mechanical tree thinning would occur within Mexican spotted owl protected activity centers (MSO PACs) with a desired condition of trees greater than 16 inches dbh contributing more than 50 percent of the stand basal area and maintaining a minimum of 40 percent canopy cover in pine-oak and 60 percent in mixed conifer per the MSO Recovery Plan (2012, pp. 276-277), followed by prescribed burning. Hand thinning up to 5 inches dbh in approximately 80 percent of the Schultz Creek Nest Core and prescribed burning in all nest cores would occur. In addition, hand thinning up to 9 inches dbh in the DLH, mechanical thinning up to 24 inches dbh on MM, and prescribed burning at both areas would also occur within MSO nest/roost habitat in coordination with the US Fish and Wildlife Service (FWS) to reduce the potential for high severity wildfire (See Table 11 for more information). No cable logging would occur within MSO nest cores and no temporary roads would be located within MSO nest cores. Some treatments proposed within occupied PACs may need to occur during the breeding season (March 1-August 31) and would be coordinated with FWS. Treatments in nest cores would not occur during the breeding season.

Prescribed fire would include initial pile burning to remove slash accumulated through harvesting, followed by broadcast burning. In areas where fuel loading allows, broadcast burning may occur prior to thinning. Maintenance burning may occur every five to seven years following implementation in order to maintain lower fuel loading levels and to restore a frequent, low-severity fire regime. Mixed conifer on steep slopes may only receive one broadcast burn through the life of the project due to the difficulty of implementation in these fuel types and terrain, and also because the historic Fire Return Interval in some vegetation types is historically longer than the life of this project. Prescribed burning techniques in wet mixed conifer would target accumulated dead and down material rather than using broadcast burning ignition patterns. Other slash removal options as described in the Implementation Methods section could also be used in lieu of burning, including biomass removal.

Figure 26: Alternative 2 Proposed Treatments, DLH

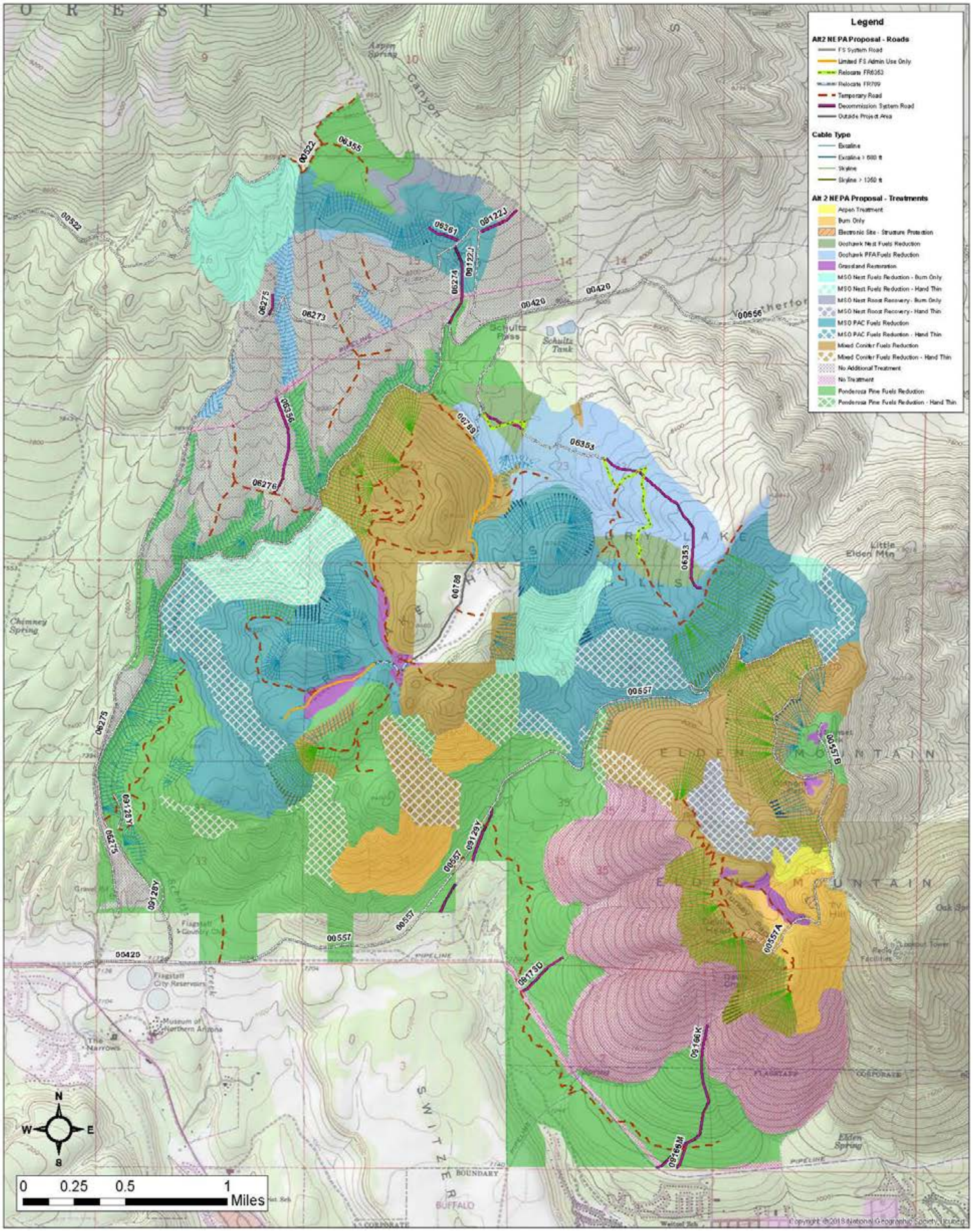


Figure 27: Alternative 2 Proposed Treatments, MM

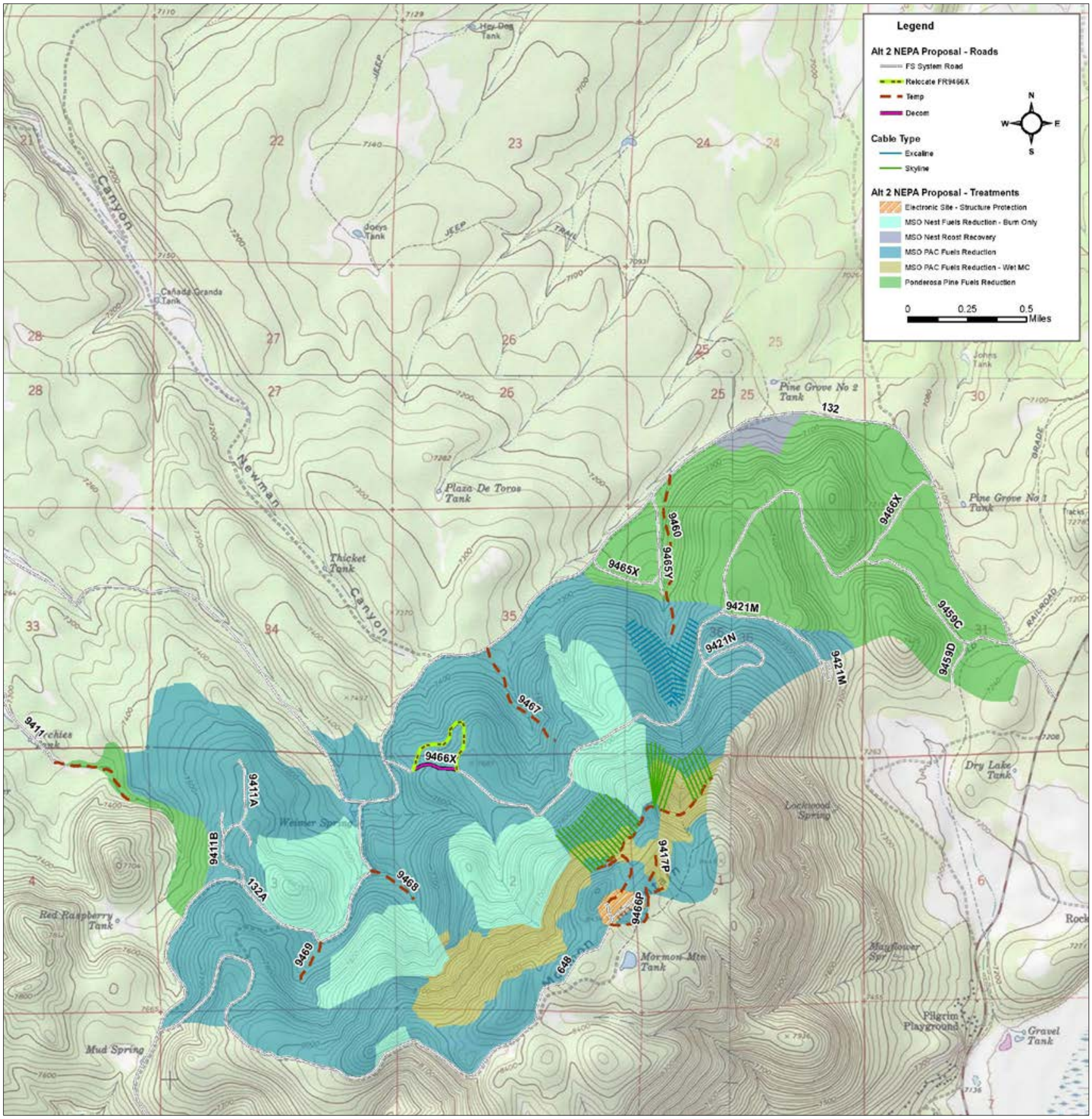


Table 11: Alternative 2 Proposed Treatment Descriptions, Objectives and Acres[9]

Treatment Type	Treatment Description/Objective	Acres
Ponderosa Pine Fuels Reduction (Northern goshawk LOPFA areas)	These treatments areas are outside of MSO PACs and northern goshawk PFAs and nest cores. Mechanical treatment designed to develop uneven-aged structure and a mosaic of openings and tree groups of varying sizes. Openings would occupy approximately 20 percent of the treatment area. Tree groups would vary in shape, size, density, and number: generally from 0.05 – 0.7 acres in size with residual group basal areas of 20-80 ft2 per acre and 2-40 trees per group.	1865 – Dry Lake Hills (DLH) 766 – Mormon Mountain (MM)
Ponderosa Pine Fuels Reduction – Hand Thinning (Northern goshawk LOPFA areas)	This treatment includes steep areas that have low tree density and/or are dominated by smaller diameter trees where the purpose and need can be met through hand felling treatments. Where practical and feasible, treatments would be designed to develop uneven-aged structure and a mosaic of tree groups of varying sizes similar to the treatment described above.	150 - DLH
Mixed Conifer Fuels Reduction (MSO Recovery areas)	These treatments areas include dry mixed conifer areas outside of MSO PACs, replacement nest/roost habitat, and northern goshawk PFAs and nest cores, but include MSO restricted habitat. Mechanical treatment designed to develop uneven-aged structure and a mosaic of openings and tree groups of varying sizes. Trees above 24” dbh would not be cut except if necessary for cable corridor locations.[10] Openings would occupy about 10-20 percent of the treatment area. Tree groups would vary in shape, size, density, and number: generally less than one acres in size with residual group basal areas of 30-90 ft2 per acre and 2-50 trees per group.	1140 - DLH
Mixed Conifer Fuels Reduction – Hand Thinning (MSO Recovery areas)	This treatment includes areas where fuels reduction objectives can be met through hand thinning of trees $\leq$ 9” dbh; where mechanical treatment could cause high levels of resource damage; or where mechanical treatments would be cost-prohibitive.	132 - DLH

[9] Table 20 describes the harvesting method for each treatment type

[10] Cable corridors require the removal of trees within the corridor itself as well as hazard trees within the cable logging unit to ensure safe operations.

Treatment Type	Treatment Description/Objective	Acres
MSO PAC Fuels Reduction - Wet Mixed Conifer	This treatment would create small openings by hand within and around aspen patches to promote regeneration. Dead and down material would be piled for burning to reduce the heavy fuel loading and allow for lower-intensity prescribed burning. Trees over 18" dbh would not be cut. Piles would be placed in openings to the extent possible to reduce fire damage to large trees.	180 - MM
MSO PAC Fuels Reduction	Mechanical treatment to create a diversity of tree patch sizes with minimum patch size of 2.5 acres. Provide for 10 percent openings across treatment areas from 0.1 – 2.5 acres in size. Maintain a minimum of 40 percent canopy cover in pine/pine-oak and 60 percent in mixed conifer. Post-treatment, trees greater than 16" dbh would contribute at least 50 percent of the stand basal area per MSO Recovery Plan desired conditions (2012, pp. 276-277). Trees above 18" dbh would not be cut except if necessary for cable corridor locations.	1167 – DLH 1592 - MM
MSO PAC Fuels Reduction – Hand Thinning	This treatment includes steep areas which have low density and dominated by smaller trees or are in areas not conducive to cable yarding operations. Where feasible, treatments would have similar objectives to those described in the MSO PAC Fuels Reduction treatment above, with the limitation that cutting would be limited to trees up to 9" dbh due to the constraints of hand thinning operations. Otherwise treatments would be thin from below up to 9" dbh to reduce density and fuel ladders.	202 – DLH
MSO Nest Fuels Reduction - Hand Thinning	Hand thinning up to 5" dbh would occur within 80% of the Schultz Creek nest core in coordination with the US Fish and Wildlife Service. Approximately 20% of the nest core would be deferred from treatment in order to maintain denser patches for habitat. Residual basal area would be a minimum of 110 ft2, and treatment would maintain a minimum of 60% canopy cover in mixed conifer. This nest core would also receive the prescribed burning treatment described below.	122 – DLH
MSO Nest Fuels Reduction - Burn Only	In all nest cores other than the Schultz Creek nest core, treatment would consist of low-intensity burning only. Dead and down material in MSO nest cores would be piled	261 – DLH 402 – MM

Treatment Type	Treatment Description/Objective	Acres
	by hand and burned.	
MSO Recovery Nest/Roost - Hand Thinning	Hand thinning up to 9" dbh would occur on 72 acres in DLH under this treatment, and dead trees less than 12" dbh and down material would be cut and piled by hand for prescribed burning.	72 - DLH
MSO Recovery Nest/Roost - Burn Only	Thirty-seven acres of Recovery Nest/Roost replacement habitat would be prescribed burned only (no hand thinning). Snag retention guidelines identified in the Forest Plan would still be followed (see Design Features – Snags). Treatments would be designed to move the stands towards minimum desired conditions: Residual basal area of 110 ft2 in ponderosa pine, and 120 ft2 in mixed conifer; canopy cover of 40 percent in pine/pine-oak and 60 percent in mixed conifer; 12 trees per acre greater than 18" diameter; trees from 12-18" dbh would comprise over 30 percent of stands BA, and trees greater than 18 inches would comprise an additional 30% of BA.	37 - DLH
MSO Recovery Nest/Roost– Mechanical Thinning	Mechanical treatment would remove ponderosa pine in a variety of size classes however, no trees > 18" dbh would be cut. Treatments would be designed to maintain a minimum residual basal area of 110 ft2; canopy cover of 40 percent with 12 trees per acre greater than 18" diameter; trees from 12-18" dbh would comprise over 30 percent of stands BA, and trees greater than 18 inches would comprise an additional 30% of BA. No oak would be cut.	22 - MM
Northern Goshawk Post Fledging Areas (PFA) Fuels Reduction	Mechanical treatment would remove ponderosa pine in a variety of size classes however, no trees > 18" dbh would be cut. Treatments would be designed to maintain a minimum residual basal area of 110 ft2; canopy cover of 40 percent with 12 trees per acre greater than 18" diameter; trees from 12-18" dbh would comprise over 30 percent of stands BA, and trees greater than 18 inches would comprise an additional	359 - DLH

Treatment Type	Treatment Description/Objective	Acres
	30% of BA. No oak would be cut.	
Northern Goshawk Nest Fuels Reduction	Mechanical treatment designed to develop northern goshawk nest stand conditions consisting of a contiguous over-story of large trees. Forest Plan guidelines for canopy cover would be met: canopy cover would vary from 50 to 70 percent.	100 - DLH
Aspen Treatment	A variety of different treatments would be used to promote and protect aspen health and regeneration, including the removal of post settlement conifers within 100 feet of aspen clones, prescribed fire, ripping, planting, fencing and/or cutting of aspen to stimulate root suckering.	22 – DLH
Grassland Restoration	Mechanical treatment to remove encroaching post-settlement conifers and restore the pre-settlement tree density and patterns.	60 – DLH
Burn Only	Burn only treatment would remove excessive fuel loading in areas which were previously burned by the 1977 Radio Fire.	270 - DLH
Electronic Site – Structure Protection	These sites are occupied by telecommunication facilities, and would be treated to provide a sufficient defensible space around these structures from a wildland fire. Individual trees that are determined to contribute to wildfire hazard or pose a hazard to the electronic sites would be removed. The remainder of the sites would receive a thin from below to approximately 20 – 40 ft2 basal area with the purpose of raising the crown base height and leaving the largest and most fire resistant trees.	6 – DLH 12 - MM
No Treatment (No New Analysis)	These acres include non-treatable areas, including rock faces and boulder fields, and the Orion Timber Sale (approximately 837 acres). Though the Timber Sale is within the project boundary, the treatments for that area were analyzed and authorized under the Jack Smith Schultz Fuels Reduction and Forest Health Restoration Project Decision Notice/Finding of No Significant Impact (2008). No additional treatments within the Timber Sale area are proposed under FWPP.	1605 - DLH

Harvesting Methods

Under Alternative 2, cable logging would be used to treat approximately 1,185 acres in the DLH and 106 acres on MM, based on slope steepness and terrain[11]. This would also include areas that are yarded with an off-road cable yarder known as an excaliner (see Table 12). On DLH, an estimated 191 acres would fall within the approximately 12-foot wide cable corridors themselves; MM would have approximately 14 acres, some of which falls within the wet mixed conifer fuel type. Though treatments proposed for wet mixed conifer would not require the use of cable logging systems, treatments in the dry mixed conifer lower on the slope would. Thus, in order for the dry mixed conifer areas to be treated, cable logging corridors would have to cross some portions of wet mixed conifer due to its location on the slope. Landings would be located at the top of the cable corridors, typically on or adjacent to roads. Cable logging was chosen as the treatment method based on its ability to remove material on steep, rocky slopes cost-effectively. If a market for biomass[12] exists during the time of implementation, biomass removal methods may be utilized in place of pile burning in areas identified for potential ground based harvesting, particularly in areas adjacent to residential property.

Table 12: Alternative 2 Harvesting Methods for DLH

Treatment Type	Excaline/ Hand Cut	Excaline / Machine Cut	Ground-based	Hand Cut/Piled	Burn Only	Skyline/ Hand Cut	Skyline/ Machine Cut	Machine Cut/Piled	TOTAL
Ponderosa Pine Fuels Reduction	82	170	1613						**1,865**
Ponderosa Pine Fuels Reduction – Hand Thinning				150					**150**
Mixed Conifer Fuels Reduction	64	15	626			225	210		**1,140**
Mixed Conifer Fuels Reduction – Hand Thinning				132					**132**
MSO PAC Fuels	26	177	793			46	110	15	**1,167**

[11] Refers to areas where the majority of the stand is being treated through cable logging methods, includes exaclining and skylining

[12] Biomass is defined as material from trees and woody plants, including limbs, tops, needles, leaves and other woody parts that are the by-products of vegetation management activities.

Treatment Type	Excaline/ Hand Cut	Excaline / Machine Cut	Ground-based	Hand Cut/Piled	Burn Only	Skyline/ Hand Cut	Skyline/ Machine Cut	Machine Cut/Piled	TOTAL
Reduction									
MSO PAC Fuels Reduction – Hand Thinning				202					**202**
MSO Nest Fuels Reduction				122	261				**383**
MSO Nest/Roost Recovery				72	37				**109**
Goshawk PFA Fuels Reduction		60	299						**359**
Goshawk Nest Fuels Reduction			100						**100**
Aspen Treatment				22					**22**
Grassland Restoration			60						**60**
Burn Only					270				**270**
Electronic Site-Structure Protection			6						**6**
No Treatment/ No New Analysis	-	-	-	-	-	-	-	-	**1605**
TOTAL	**172**	**422**	**3,497**	**699**	**568**	**271**	**320**	**15**	**7569**

Table 13: Alternative 2 Harvesting Methods for MM

Treatment Type	Excaline/ Machine Cut	Ground-based	Hand Cut/Piled	Burn Only	Skyline/ Machine Cut	TOTAL
Ponderosa Pine Fuels Reduction		767				**767**
MSO PAC Fuels Reduction	33	1519			40	**1,592**
MSO PAC Fuels Reduction – Wet Mixed Conifer			147		33	**180**

Treatment Type	Excaline/ Machine Cut	Groun d-based	Hand Cut/Pile d	Burn Only	Skyline/ Machine Cut	TOTA L
MSO Nest Fuels Reduction				402		**402**
MSO Nest/Roost Recovery		22				**22**
Electronic Site-Structure Protection		12				**12**
TOTAL	**33**	**2,320**	**147**	**402**	**73**	**2,975**

Campfire Closure Order

The proposed action would also include establishing a permanent campfire restriction order in the DLH portion of the project area to limit the potential for human-caused wildfire. The current temporary campfire restriction order (Number 04-15-05-F) has been in effect since June, 2011 (reissued June 2013 for two years and again on June 8,2015), and prohibits building, maintaining, attending, or using a fire, campfire[13], or stove fire[14] (36 CFR § 261.52(a)). The Proposed Action would extend this order permanently in the project area.

Temporary Closure Orders

There may be a need to temporarily close portions of the project area to the public during implementation due to safety concerns related to heavy machinery on steep slopes and log hauling and equipment on and/or adjacent to roads and trails, as well as prescribed burning activities. The closures could apply to the area being treated as well as the truck haul routes in use and any trails within or immediately adjacent to the treatment area. The closures would likely be short in duration and specific to the area where machines are operating. For harvesting units, area closures may last up to one year; for prescribed burning areas, closures may last from one to five days. After timber cutting and removal are competed, the closure order would be lifted and the public would be able to access the area again. The closures would be communicated with the public prior to their taking affect, and reroutes of affected trails (where possible) would be identified and communicated as well.

Forest Plan Amendments

The Coconino National Forest is currently operating under the 1987 Coconino Land Management Plan, as amended; however the Forest is in the process of revising the Forest Plan, with the Record of Decision (ROD) for the revised plan anticipated for release in 2016. Depending on the timing of the release of the final Forest Plan document, the final FWPP analysis will be consistent with the revised Forest Plan. The following three project-specific Forest Plan amendments would only be required if a decision for this project is signed prior to implementation of the revised Forest Plan. In other words, no Forest Plan amendments would be anticipated if FWPP is implemented under the revised Forest Plan. If the amendments are necessary, this project would be amending the Forest Plan under the 2012 Planning Rule (36 CFR 219.13).

[13] Campfire: means a fire, not within any building, mobile home or living accommodation mounted on a motor vehicle, which is used for cooking, personal warmth, lighting, ceremonial, or aesthetic purposes. Fire includes campfire.

[14] Stove fire: means a campfire built inside an enclosed stove or grill, or a portable brazier, including wood and charcoal fires.

A site (project) specific plan amendment is a one-time variance in Forest Plan direction for the project; Forest Plan direction reverts back to its original language/direction upon completion of the specified project. The language proposed does not apply to any other forest project.

All three of the action alternatives would require two of the proposed Forest Plan amendments, Amendment 1 and Amendment 2, summarized below. In the Proposed Action sent out for scoping in April 2013, three Forest Plan amendments were proposed, the two summarized below as well as one for canopy cover and interspaces. After further analysis of the existing and desired conditions along with review of scoping concerns, the IDT decided that the amendment was not necessary to meet the objectives of fuels reduction and fire hazard abatement.

More information about canopy cover measurements and openings can be found in the Silviculture section of Chapter 3 and in the Silviculture Specialist Report, located in the project record.   Appendix A contains more detailed information on the amendments.

Amendment 1: The purpose of this amendment would be to facilitate treatment in high-priority locations such as Mexican spotted owl occupied habitat to prevent high-severity wildfire from removing nest/roost habitat. This is based on language in the Mexican Spotted Owl Recovery Plan (2012), which states, “[wildfires] result in the most significant alteration of owl habitat and hence, have the greatest potential for loss of habitat” (USDI 2012).

The current Forest Plan adopted language from the previous MSO Recovery Plan (USDI 1995). For this project, a Forest Plan amendment would utilize some of the more updated management direction in the revised recovery plan where it is different than what is currently included in the Forest Plan. The proposed Forest Plan amendment would modify Forest Plan language to allow mechanical treatments in MSO PACs up to 18 inches dbh, hand thinning treatments up to 5 inches dbh in the Schultz Creek nest core, and prescribed burning within all MSO nest/cores. The amendment would also allow removal of trees 24 inches dbh and greater in MSO protected and recovery habitats for cable logging corridors in order to facilitate treatments under Alternative 2, and would allow temporary road construction to occur within MSO PACs under all three action alternatives. Additionally, Alternatives 2 and 3 would remove all snags in cable and helicopter logging areas for safety reasons, the effects of which are analyzed in Chapter 3. The monitoring requirement specified under the Forest Plan would be amended to include the monitoring plan developed by the Forest Service, U.S. Fish and Wildlife Service, and the Rocky Mountain Research Station referenced in the following section titled, “Monitoring.” This amendment would also remove timing restrictions within MSO PACs for the duration of the FWPP project. Treatments within PACs would be accomplished as quickly as possible to reduce the duration of impacts, and would be coordinated with FWS. Timing restrictions would still apply for treatments within MSO nest cores. The purpose of this amendment would be to facilitate treatment in high-priority locations such as Mexican spotted owl occupied habitat to prevent high-severity wildfire. This is based on language in the Mexican Spotted Owl Recovery Plan (2012), which states, “[wildfires] result in the most significant alteration of owl habitat and hence, have the greatest potential for loss of habitat.”

Amendment 2: The current Forest Plan restricts the use of mechanical equipment to slopes less than 40 percent. Amendment 2 would remove the restrictive language related to 40 percent slopes and also the language identifying slopes above 40 percent as inoperable in order to allow mechanical harvesting on slopes greater than 40 percent within the project area.

It would be necessary to allow for use of specialized mechanical equipment to cut and remove trees on steep slopes to reduce the potential for high-severity wildfire in this project area due to the preponderance of areas with greater than 40 percent slope in the project area. Furthermore, since the Forest Plan was written and amended, mechanized ground-based equipment has progressed to be able to operate on steep slopes more effectively with less damage to the soils. While this specialized equipment is not commonplace in this region due to the high cost of its use, the approval of the City bond makes the use of such equipment a possibility for this project. In order to be able to utilize such equipment to treat slopes above 40 percent in the project area and meet the purpose and need, this Forest Plan amendment is needed.

Monitoring

Mexican Spotted Owl

The Mexican Spotted Owl Recovery Plan, First Revision (USFWS 2012) provides guidance for these treatments and emphasizes the need for monitoring and feedback loops to allow management to be adaptive. Well-designed monitoring would provide valuable information on the effects of these activities on the owls and their habitat. For FWPP this is of particular interest because fuels reduction treatments within mixed conifer vegetation types has not previously occurred on the Flagstaff Ranger District; additionally, hand thinning treatments and prescribed burning within MSO nest cores have also not occurred on the District, nor frequently across the southwest.

The MSO monitoring plan is designed to evaluate the effects of prescribed fire and mechanical thinning on short-term owl occupancy and reproduction, and key habitat components (as defined in the Revised MSO Recovery Plan Table C2). This monitoring plan would provide valuable information on the effects of these proposed activities on MSO and their habitat. For FWPP this is of particular interest because fuels reduction treatments within mixed conifer vegetation types have not previously occurred on the District. Additionally, hand thinning treatments and prescribed burning within MSO nest cores have also not occurred on the District. The Mexican spotted owl Recovery Plan (USFWS 2012) states that if thinning and burning are to occur in PACs that monitoring of treatment effect on owls is conducted. In order to meet this need, the Forest Service worked with the FWS to develop a monitoring plan for this project that would assist in determining the effects of thinning and burning on MSO and their habitat (Appendix B). The monitoring plan includes the details for sample selection, treatment specifics, and measurement protocols including timing, and planned analyses. The monitoring plan was developed with FWS in order to meet the Recovery Plan guidelines for conducting fuels treatments in PACs. In addition, the Forest Service and FWS worked with Dr. David Huffman of the Ecological Restoration Institute (ERI) of Northern Arizona University to design and implement the vegetation monitoring component of the project.

The proposed monitoring plan would pair treated and untreated (or reference) PACs within DLH and MM portions of the project and compare occupancy rates, reproduction rates, and vegetation (habitat) changes. Reference PACs match the environmental conditions in PACs where treatments are proposed, as closely as possible.

ERI is working with the Forest Service and FWS to coordinate monitoring efforts within the MSO treatment and reference PACs identified in the MSO monitoring plan to analyze treatment effects on habitat components, such as tree species composition and structure.

Habitat Monitoring

The Ecological Restoration Institute (ERI) of Northern Arizona University is working with the Forest Service and FWS to coordinate monitoring efforts within the MSO reference PACs identified in the MSO monitoring plan to meet multiple objectives, including but not limited to treatment effects on habitat components, such as tree species composition and structure. ERI would be issued a long-term research permit with the finalization of a Record of Decision for FWPP in order to perform habitat monitoring in the DLH and on MM in coordination with the Forest Service and FWS.

Red Squirrel

Red squirrels play an important role in forest ecology and restoration as they are excellent indicators of changes as a result of forest treatments. Red squirrels require a forest structure that provides large areas of closed canopy and large trees that produce an abundant cone crop. The Forest Service and AZGFD have developed a red squirrel monitoring outline in order to establish long-term trends in populations and habitat use and the effects of forest thinning treatments on red squirrels. The monitoring outline provided in Appendix B is a framework only, and can be adjusted and adapted as necessary to most effectively conduct monitoring.

Soil/Watershed Responses

Implementation and effectiveness monitoring of best management practices (BMPs) listed in the Design Features would occur in accordance with the National Core BMP Monitoring Protocols (in preparation, FS-900b). Monitoring would determine whether the BMPs are being implemented as planned and whether they are effective.

Fire and Fuels

In the last two years, Flagstaff Ranger District fuels personnel have started to monitor the effects of prescribed burning in different project areas. Specific protocols have been developed from a combination of the Firemon and FSVeg protocols and following the DRAFT Region 3 Vegetation Monitoring/Sampling Protocols (updated December 2008).   The forest characteristics that are measured pre and post fire/prescribed burn in the managed fire and prescribed fire protocols are described in detail in Appendix B and include overstory trees, pole sized tree or saplings, seedlings, snags, fuel loading, and CBI (composite burn index which assessed burn severity) which is solely performed postfire and under special severe wildfire or prescribed fire situations. CBI methodology and protocols would only be implemented when the District Fuels Specialist deemed necessary.

Required Transportation System

The Forest Plan directs the forest to:

"Provide and manage a serviceable road transportation system that meets needs for public access, land management, resource protection, and user safety. Provisions are made for the construction and reconstruction, maintenance, seasonal and special closures of Forest roads; and obliteration of unnecessary roads," (1987, as amended).

To achieve the objectives of the FWPP, a transportation system would be needed in order to access the area with log trucks, chip vans and other equipment needed to perform the required fuel reduction and timber removal work. Access is also needed for work such as non-commercial tree thinning and prescribed burning.

The three action alternatives have different transportation system requirements for two reasons. First, the same acres are not treated under all alternatives. This changes the access needs and the transportation system required. Secondly, different alternatives employ different harvest systems that have their own unique transportation requirements.

Transportation systems used under all action alternatives would utilize a combination of existing Forest Service system roads, Forest Service system roads that are relocated to reduce erosion, one decommissioned road that would be converted to a system road, new temporary roads and temporary roads that would be placed on existing road prisms. Roads that are no longer needed for management of the National Forest would also be decommissioned under this EIS.

This section details the transportation system that would be needed to carry out the project under each of the alternatives and any changes that are proposed to the current travel management road status.

Road Systems Common to All Action Alternatives

<u>Road Relocations</u>
Under all alternatives, three roads within the project area are being proposed for partial relocation. These roads are FR 9466x at Mormon Mountain, FR 6353 and FR 789 in the DLH area.

FR 9466x- This is road is currently limited to Forest Service administrative use only. The majority of this road has an acceptable grade. However approximately 0.19 miles are a steep grade, (up to 14 percent) on shelf rock that is barely passable to a 4-wheeled drive pick-up. It is not suitable as a haul route for log trucks. This unusable segment would be decommissioned and replaced by a road segment of approximately 0.53 miles that would have a grade of approximately 8 percent. This would reduce erosion from the road's surface and facilitate use by log trucks and chip vans. FR 9466x's travel management status would remain, "Limited Forest Service administrative use only." This road would not be open to the public for motorized use under any alternative.

FR 6353- This is road is currently limited to Forest Service administrative use only. Much of this road is usable for log hauling in its currently location. However approximately 1.12 miles have segments where grades are up to 16 percent and the road is oriented straight up and down the slope. In many of these areas the road has been eroded nearly 1.5 feet deep. These road segments are an ongoing erosion problem and would be very difficult to drain the water from due to the orientation straight up and down the slope and the fact that they are now deeply incised into the ground. These segments would be decommissioned and replaced with roads that have an 8 percent grade or less and be constructed so that they have a side that the water can be diverted off the road to prevent water running the length of the road causing erosion. FR 6353's travel management status would remain, "Limited Forest Service administrative use only." This road would not be open to the public for motorized use under any alternative.

FR 789- FR 789 begins at a junction with the FR 420, (the Schultz Pass road). The old road location crosses Schultz creek at this point and is currently closed with a gate. It then climbs to the mesa on top of the Dry Lake Hills and passes through a parcel of land owned by the Navajo Nation. The road passes close to the seasonal lake on the top of Dry Lake Hills and terminates on the western edge of mesa at the steep slopes that overlook the Cheshire neighborhood. While the road location is evident throughout its route, in some places it has been reduced to little more than a trail; this occurs mainly to where it passes through flat grasslands.

FR 789 provides the only access to the top of the Dry Lake Hills; however this road is currently decommissioned. Under the current proposal there are a number of temporary spur roads that would branch off from it in all alternatives. FR789 would also provide access for fire protection for the entire area between the Schultz Pass road and the Elden Lookout road. This road is also needed to provide access for thinning, fuel reduction work and prescribed burning after timber harvesting. For these reasons FR789 would be restored to the Coconino Forest road system with a travel management status of “Limited Forest Service administrative use only.”

Road 789 would be relocated or rerouted in two areas. It would be rerouted to an existing road prism that is now used as a trail at segment “E” on the transportation map for all alternatives. Road 789 would no longer begin at the junction with the 420 road, it would tie into the 6353 road and have its beginning at that point. FR 789 would also be relocated at segment “HH” on the transportation map. This would allow the road to avoid an unusably steep segment.

As mentioned earlier FR 789 passes through a parcel of land owned by the Navajo Nation. If it is not possible to utilize this portion of FR789, the road would be rerouted to use segments FF and P which are currently planned as temporary roads. If FR 789 is rerouted onto these segments they would become part of FR789.

This road would not be open to the public for motorized use under any alternative.

<u>Haul Routes: Use of Public Roads by Forest Service Contractors</u>
Forest Service contractors have the right to legally use public roads within and outside of the project area, subject to regulation by the public entity charged with jurisdiction of that roadway. In order to move timber from the project area to processing facilities, it would be necessary for heavy trucks to use public roads through a portion of the city of Flagstaff. The Forest Service may only restrict haul routes or timing of routes used by contractors on the National Forest in order to provide for public safety. The Forest Service cannot dictate the routes the contractor uses once they leave the forest. The routes here are only potential options that could be used.

Dry Lake Hills

This project would utilize several primary haul routes for log trucks and chip vans. For the Dry Lake Hills portion of the project these roads would be FR 557, the Elden Lookout road, FR 420 the Schultz Pass road, FR 556 the Elden Springs road and FR 522 and FR 516 the Snowbowl road. All of the timber removed from Mt Elden and the timber from the flats to the west of Mt Elden would use the Mt Elden Lookout road to its junction with the Schultz Pass road and then enter State Highway 180. Under Alternatives 2 and 3, approximately 3,800 truckloads would use this route. Under Alternative 4 approximately 2,600 truckloads would use this route.

Nearly all of the area between Mt Elden Lookout road and Schultz Pass road as well as a portion of the project north of the Schultz pass road either be hauled down the Schultz Pass road to Highway 180 or on FR 556, the Elden Spring road to US Highway 89. Under Alternatives 2 and 3 approximately 5,200 truckloads would use these routes. Under Alternative 4 approximately 4,200 truckloads would use these routes.

The very northern portion of the project would be hauled on FR 522 to the Snowbowl road and then onto State Highway 180. Under alternatives 2 and 3 approximately 200 truckloads would use this route. Under Alternative 4 no loads would be hauled on this route.

Trucks that haul onto State Highway 180 would most likely use N. Switzer Canyon Road to reach east Route 66. These loads would use Ponderosa Parkway and E. Butler Ave to enter Interstate 40 at the east Butler Ave interchange, exit 198. Trucks hauling to US Highway 89 would likely use East Route 66 to Country Club Drive and enter Interstate 40 at the Country Club interchange, exit 201. However, as mentioned previously, these are potential route options; the Forest Service cannot dictate where the contractor(s) go once they leave the National Forest.

Mormon Mountain

Timber hauled from Mormon Mtn. could be either hauled to Interstate 17 at Munds Park via FSR 240 or onto the Lake Mary road via county road 90. Both of these routes would utilize FR 132, 132A, 648 and 240 as well as County road 90. Under alternative 2 approximately 4,800 truckloads would haul on these routes. Under Alternatives 3 and 4 approximately 4,700 truckloads would use these routes.

Temporary Roads

Existing roads would be used to the extent possible for hauling harvested trees. Forest Roads (FR) 420, 556 and 557 would be used as the main haul routes for DLH; FR 132, 132A, and 648 would be used as the main haul routes for MM. Maintenance on these roads would be necessary prior to implementation, including reconditioning and resurfacing of FR 420, 556 and 132. In addition, there may be a need to transport harvested trees through the City of Flagstaff to access the Interstate system (I-40 and I-17).

However, it is likely that not all treatment areas would be accessible by existing roads. The exact number temp roads required varies by alternative (see the discussion of alternatives below). Temp roads are designed to serve as short term access to a specific area for timber removal and follow up treatments such as prescribed burning. Where possible, temporary roads would be located on existing road prisms (e.g. where historic road beds are still identifiable); however new temporary roads in previously undisturbed areas are also anticipated (see Table 28). The locations of temporary roads are estimated based on treatment areas. The precise location of temporary roads cannot be determined until a contract for treatment is secured and the type of equipment to be used is determined; however no temporary roads would be located within MSO nest cores. All temporary roads, landings, and skid trails used would be pre-approved by the Forest Service Timber Sale Administrator in accordance with resource protection measures. In addition, three roads within the project area are being proposed for partial relocation. These roads are FR 9466x on MM (approximately 0.53 miles relocated), and FR 6353 and FR 789 in the DLH area (approximately 1.57 miles relocated total).

Following completion of work in the area they serve, these temp roads would be rehabilitated and made impassable to vehicles. Rehabilitation work could consist of several actions including but not limited to: re-contouring, scarifying the road surface, grass seeding, constructing earthen berms to prevent erosion and discourage traffic and placing slash on the road surface.

It is likely that road prisms of temporary roads would still be at least partially visible after rehabilitation work is completed. The term "**rehabilitation**" is used in this document to describe this type of post project work done on these roads rather than the term "decommission" in order to avoid potential confusion. **Decommissioning** as used in this document refers to removing a Forest Service system road from its current status and placing it into a decommissioned status where it is no longer considered part of the forest's road system.

The majority of the temp roads proposed in this project are "new temps." This means that a temporary road is planned in an area where no road prism currently exists. Other temp roads are being placed on an existing road prism. These existing prisms are either user created roads or are roads that have been decommissioned from the Coconino Forest's road system in the past. In either case, they are not Forest Service system roads and if they are to be used, they are considered temp roads. In the detailed roads tables for each alternative these roads are designated as "Haul Road- temp on existing road prism." Following completion of work in the area they serve, they would be rehabilitated in the same manner as new temp roads.

Changes in Road Travel Management Status

Forest Service roads are classified into several categories for travel management purposes:

Open to all vehicles- The road is open to all types of vehicles
Open to highway legal vehicles- The road is open only to highway legal vehicles
Closed- The road is closed to all vehicles and can only be opened for use by completing a NEPA document
Limited to Forest Service Administrative Use- The road is closed to all vehicles except for Forest Service vehicles on official business and those of Forest Service cooperators, contractors and permittees.
Decommissioned- The road has been decommissioned and is no longer considered a Forest Service system road. It is not open for use. If it is to be used, it must be as a new temporary road or be restored to a system road under a NEPA document.

This EIS proposes some changes in travel management status and also proposes to decommission several roads that are no longer needed for management purposes. It does not make any changes to roads that are open to the public. The current level of public access would not change. These proposed changes are listed in the detailed road listing for each alternative and are summarized in Table 14. They are the same under all action alternatives.

Road Decommissioning and Closures

The project area contains approximately 26.5 miles of roads closed to motorized travel through the Travel Management Rule (TMR) decision (September 2011). Under all action alternatives, approximately 4.19 miles in the DLH and 0.19 miles in MM of these roads would be decommissioned upon project completion. Preventing unauthorized motor vehicle use on these routes would limit the potential for human-ignited wildfires in the project area, restore forest vegetation, and reduce the potential for increased erosion subsequent to a fire. The term "rehabilitation" is used in this document to describe this type of post project work done on these roads rather than the term "decommission" in order to avoid potential confusion.

Table 14: Roads within the FWPP area, their current status and proposed status post-implementation for all action alternatives

Road Number	Mileage	Current Status	Post Project Status
789	1.829	Decommissioned/Converted	FS Admin use only
6274	0.411	FS Admin use only	Decommissioned/Converted
6275 (only a portion)	0.109	FS Admin use only	Decommissioned/Converted
6353 (Only a portion)	1.12	FS Admin use only	Decommissioned/Converted
6356	0.496	FS Admin use only	Decommissioned/Converted
6361	0.172	FS Admin use only	Decommissioned/Converted
9122 J	0.217	FS Admin use only	Decommissioned/Converted

Road Number	Mileage	Current Status	Post Project Status
9129 Y	0.445	Closed Unless Open with NEPA	Decommissioned/Converted
9166 K	0.827	Closed Unless Open with NEPA	Decommissioned/Converted
9166 M	0.134	Closed Unless Open with NEPA	Decommissioned/Converted
9173 D	0.265	Closed Unless Open with NEPA	Decommissioned/Converted
9466 X (Only a portion)	0.19	FS Admin use only	Decommissioned/Converted

Appropriate action would be taken on roads that are decommissioned under this EIS as well as previously decommissioned roads within the project area which require additional rehabilitation work to reduce erosion and discourage vehicle use. These actions could include but not be limited to: re-contouring, scarifying the road surface, grass seeding, constructing earthen berms and placing slash on the road surface.

Road Maintenance

Road maintenance on roads that receive substantial used by the public are often maintained by the Forest Service on a regular basis as funding allows. When there is a substantial increase in use of a road by a Forest Service contractor for uses such as log hauling, the associated contractor is usually required to perform maintenance both during and after their use of the road commensurate with their use. This maintenance is often blading and reshaping of the road surface. Road maintenance on roads that are closed to the public would be performed by the logging contractor.

On this project maintenance could also include applying dust abatement on approximate 0.70 miles of FR 556 and 0.25 miles on FR 420. Both of these segments are adjacent to residences where road dust has the potential to be a concern.

Alternative 2: Proposed Action with Cable Logging Proposed Transportation System

Under Alternative 2, the following actions would occur regarding road use on the DLH and MM areas, respectively.

Dry Lake Hills

System haul roads within the project area	18.07 miles
System haul roads outside the project area	14.33 miles
New temporary haul roads constructed	14.86 miles
Temporary roads on existing road prisms	2.75 miles
Temporary roads rehabilitated	17.61 miles
Relocated system road used for hauling	1.57 miles
System roads decommissioned	4.19 miles

Mormon Mountain

System haul roads within the project area	16.46 miles
System haul roads outside the project area	18.13 miles
New temporary haul roads constructed	1.07 miles
Temporary roads on existing road prisms	2.52 miles

Temporary road rehabilitated	3.59 miles
Relocated system road used for hauling	0.53 miles
System roads decommissioned	0.19 miles

Figure 28: Proposed Transportation System for Alternative 2, DLH

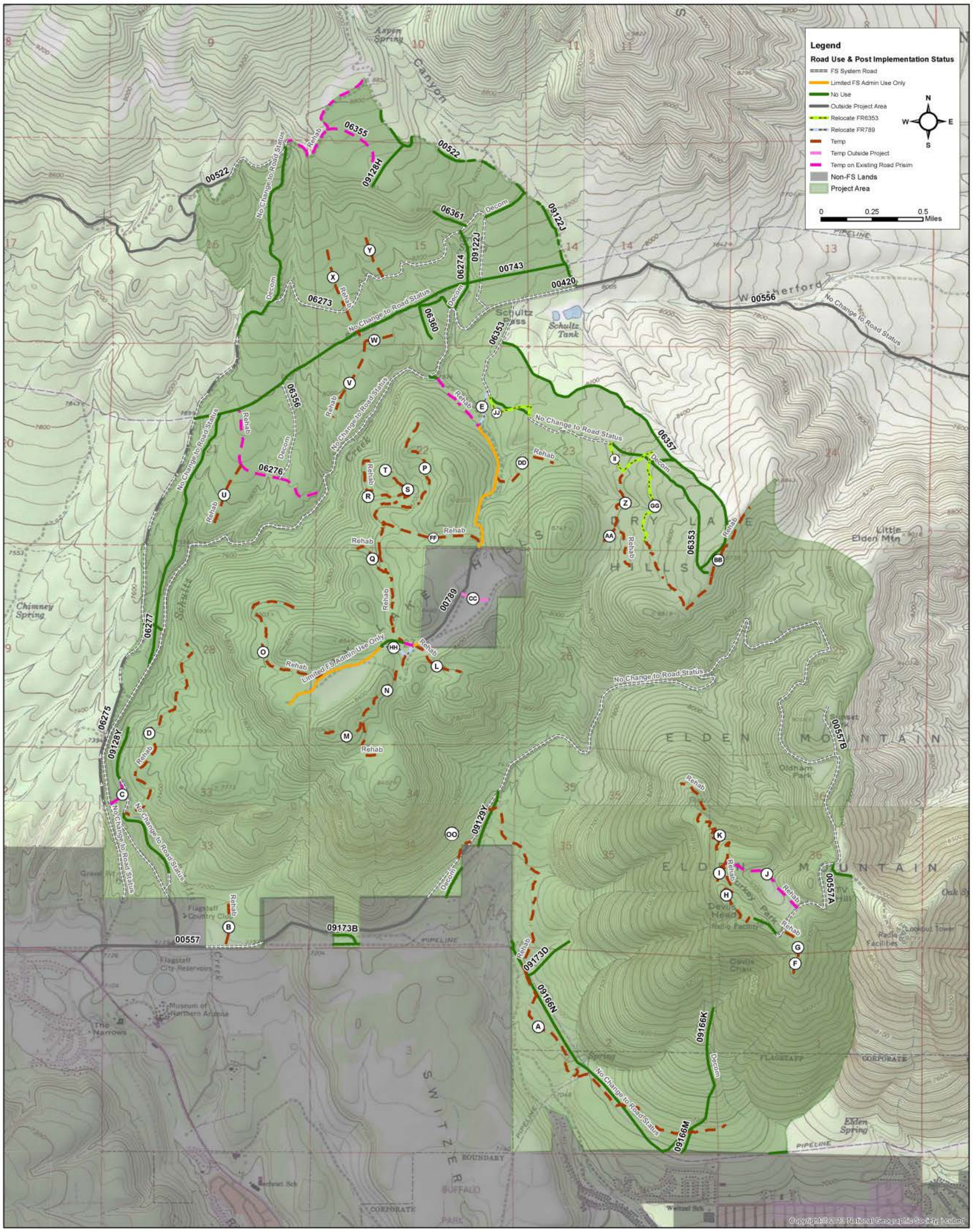
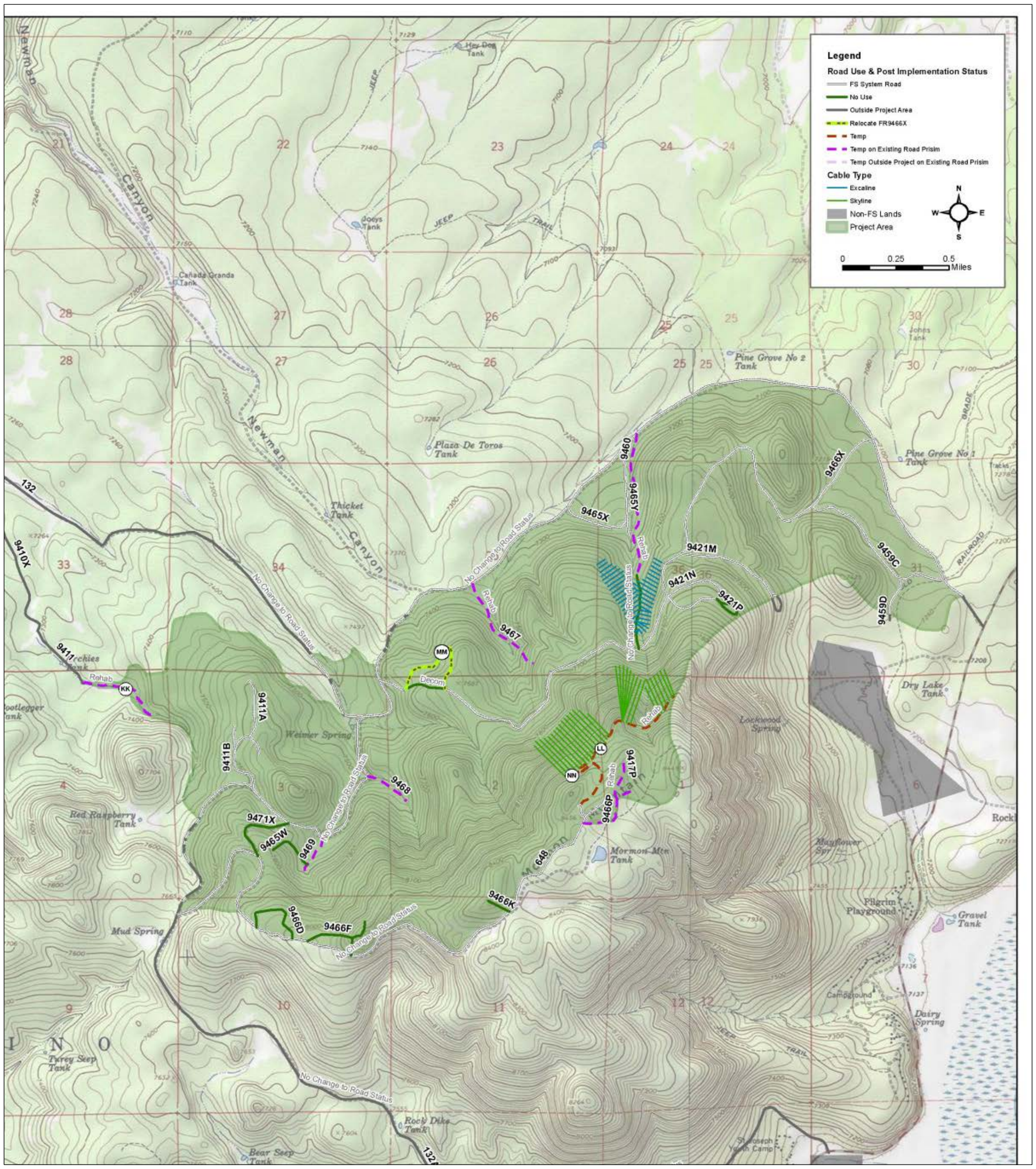


Figure 29: Proposed Transportation System for Alternative 2, MM



Design Features Specific to Alternatives 2 and/or 3

Table 15 contains only those design features specific to Alternatives 2 and/or 3. The general design features listed in Table 24 would also apply to these alternatives.

Table 15: Design Features Specific to Alternatives 2 and/or 3

Specialist Area	Related Resource	Design Feature

Specialist Area	Related Resource	Design Feature
Soils/Watershed	Timber Operations	Skid trails and cable yarding corridors would be restored after use by a combination of any or all of the following practices in order to prevent the concentration of runoff in skid trails and to protect exposed soil: reshaping the surface to promote dispersed drainage (i.e., create convex vs. concave cross-section), installation of drainage features such as water bars to shed water, and spreading slash across skid trails and cable yarding corridors to protect areas where mineral soil is exposed. Where skid trails and or cable yarding corridors intersect existing roads or trails, native materials such as logs, slash, and/or boulders would be placed along skid trail or cable corridor to line-of-sight or first 300’, whichever is greater.
Wildlife	Mexican Spotted Owl	• No cable or helicopter logging would occur within MSO nest/cores. • An implementation guide would be developed in coordination with FWS to minimize the impacts of helicopter operations (i.e. helilanding locations, flight patterns) on nesting MSO and other bird species (peregrines, eagles, northern goshawks, etc.).
	Northern Goshawk	Helicopter paths would be reviewed to exclude flights over occupied nest locations during the northern goshawk breeding season.
	Red Squirrels	• Retain all trees within a 26-foot radius from cache (1/20th acre). Within cable and helicopter units, snags may be felled within the 26-foot radius for safety reasons. Caches would still be protected and live trees would be retained except where cable corridors overlap with that buffer. Additional caches would be protected outside of cable logging units to compensate. • Leave snag patch placement would be coordinated with existing red squirrel caches.
	Snags	• In areas where large snags are cut for safety purposes, fallen trees would be left on site as needed for wildlife habitat while still lowering overall fuel loadings to meet desired conditions. • Biologists would identify patches of snags up to 10 acres in size in advance of treatment unit layout in cable and helicopter logging areas. This would allow for the protection of patches of snags at the ecosystem

Specialist Area	Related Resource	Design Feature
		management area level that could serve as a reserve area for areas/acres where we are unable to maintain snags during operations. Patch locations would be identified with consideration for red squirrel caches (see Red Squirrel Design Features above). • Where helicopter logging is used, consider using patch cuts in order to break up fuels. This would allow for the maintenance of snags outside the patches, but would allow for greater removal of trees (live and dead) and operational safety within the patches. • Use logging systems when feasible in sensitive habitats that can meet project objectives and maintain important structural components (e.g., snags, etc.).

Alternative 3: Proposed Action without Cable Logging

Alternative 3 would be similar to Alternative 2 in that the described treatments would be the same (see Table 16); however this alternative would address visual concerns and distribution of snags and large trees due to the absence of proposed cable corridors. Under Alternative 3, treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky, or inaccessible to be treated by steep slope ground-based equipment (see Table 17 and Figure 30 and Figure 31). No cable logging would occur under this alternative, which would reduce the need to remove some large trees and snags on steep slopes and also the need to create corridors. The enclosed cabs of steep-slope machinery precludes the need to remove hazard trees, and though areas proposed for treatment by helicopter would still need to have hazard trees removed, the distribution of snags and large trees could be factored into treatment placement more easily.

Figure 30: Alternative 3 Proposed Treatments, DLH

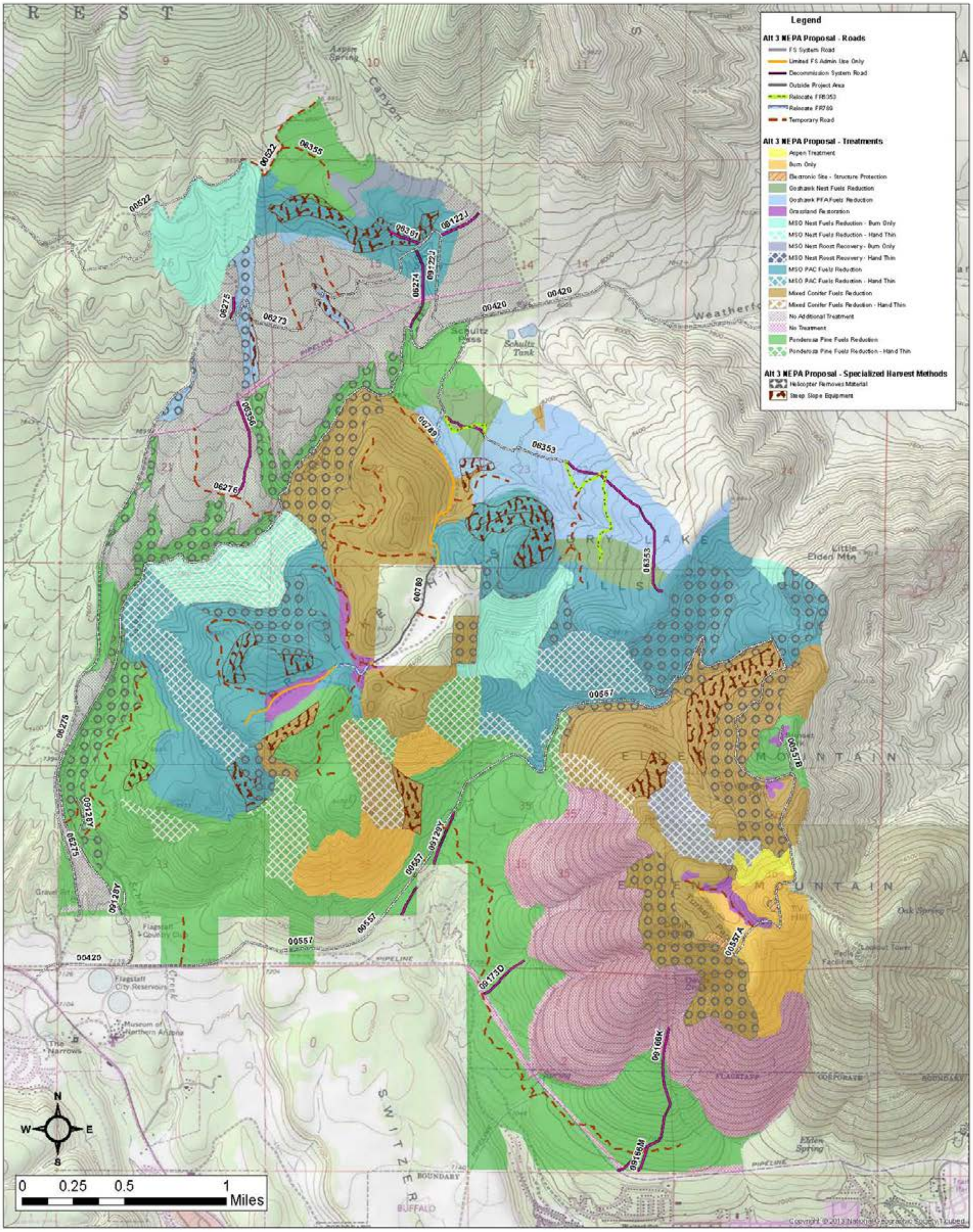


Figure 31: Alternative 3 Proposed Treatments, MM

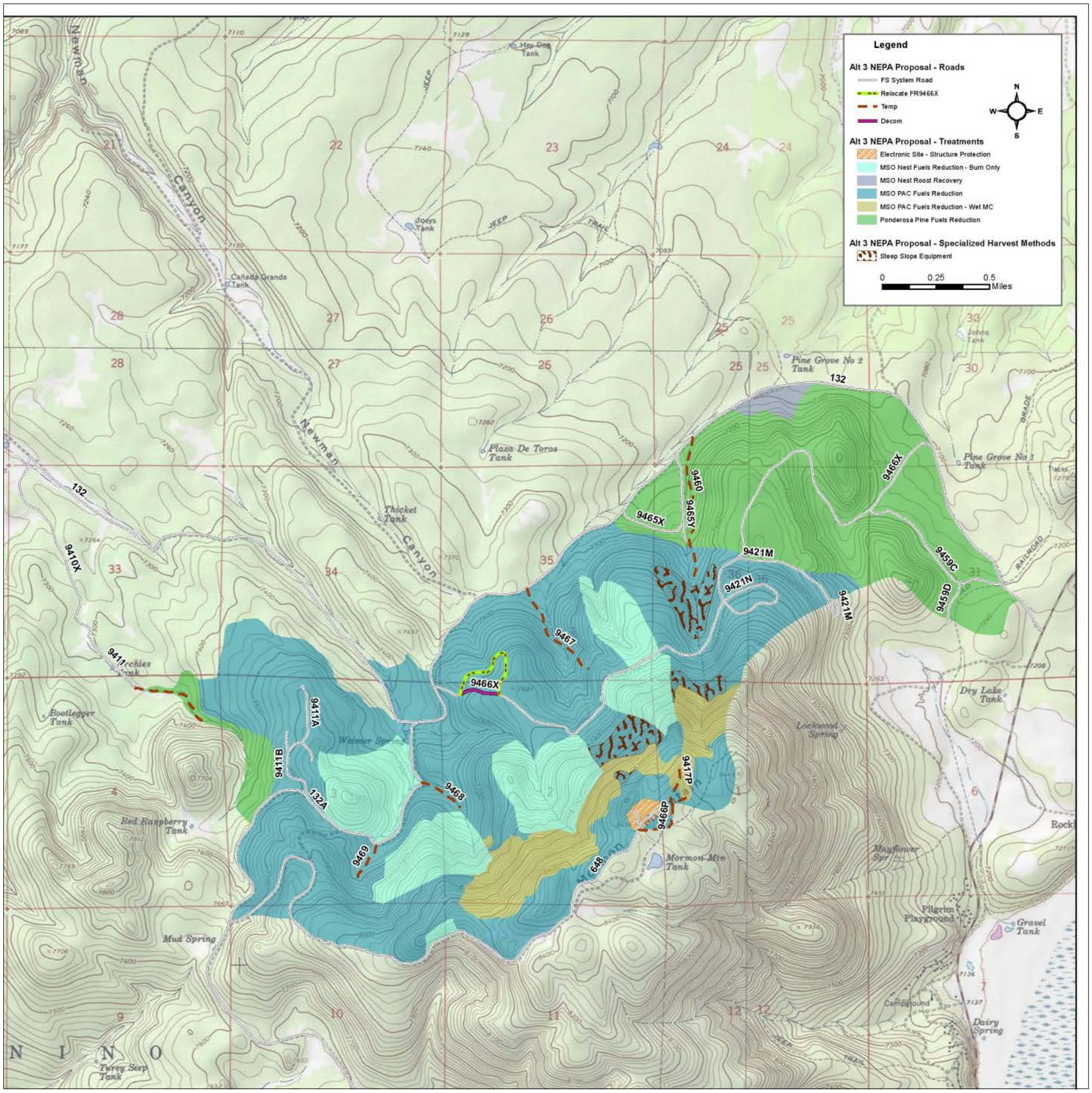


Table 16: Alternative 3 Proposed Treatment Descriptions, Objectives and Acres

Treatment Type	Treatment Description/Objective	Acres
Ponderosa Pine Fuels Reduction (Northern Goshawk LOPFA Areas)	These treatments areas are outside of MSO PACs and northern goshawk PFAs and nest cores. Mechanical treatment designed to develop uneven-aged structure and a mosaic of openings and tree groups of varying sizes. Openings would occupy approximately 20 percent of the treatment area. Tree groups would vary in shape, size, density, and number: generally from 0.05 – 0.7 acres in size with residual group basal areas of 20-80 ft2 per acre and 2-40 trees per group.	1865 – Dry Lake Hills (DLH) 766 – Mormon Mountain (MM)
Ponderosa Pine Fuels Reduction – Hand Thinning (Northern Goshawk LOPFA Areas)	This treatment includes steep areas that have low tree density and/or are dominated by smaller diameter trees where the purpose and need can be met through hand felling treatments. Where practical and feasible, treatments would be designed to develop uneven-aged structure and a mosaic of tree groups of varying sizes similar to the treatment described above.	150 - DLH
Mixed Conifer Fuels Reduction (MSO Recovery Areas)	These treatments areas include dry mixed conifer areas outside of MSO PACs, replacement nest/roost habitat, and northern goshawk PFAs and nest cores, but include MSO restricted habitat. Mechanical treatment designed to develop uneven-aged structure and a mosaic of openings and tree groups of varying sizes. Trees above 24” dbh would not be cut. Openings would occupy about 10-20 percent of the treatment area. Tree groups would vary in shape, size, density, and number: generally less than one acres in size with residual group basal areas of 30-90 ft2 per acre and 2-50 trees per group	1158 - DLH
Mixed Conifer Fuels Reduction – Hand Thinning (MSO Recovery Areas)	This treatment includes areas where fuels reduction objectives can be met through hand thinning of trees ≤ 9” dbh; where mechanical treatment could cause high levels of resource damage; or where mechanical treatments	85 - DLH

	would be cost-prohibitive.	
MSO PAC Fuels Reduction - Wet Mixed Conifer	This treatment would create small openings by hand within and around aspen patches to promote regeneration. Dead and down material would be piled for burning to reduce the heavy fuel loading and allow for lower-intensity prescribed burning. Trees over 18" dbh would not be cut. Piles would be placed in openings to the extent possible to reduce fire damage to large trees.	180 - MM
MSO PAC Fuels Reduction	Mechanical treatment to create a diversity of patch sizes with minimum patch size of 2.5 acres. Provide for 10 percent openings across treatment areas from 0.1 – 2.5 acres in size. Maintain a minimum of 40 percent canopy cover in pine/pine-oak and 60 percent in mixed conifer. Post-treatment, trees greater than 16" dbh would contribute at least 50 percent of the stand basal area per MSO Recovery Plan guidelines (2012). Trees above 18" dbh would not be cut except if necessary for cable corridor locations.	1195 – DLH 1592 - MM
MSO PAC Fuels Reduction – Hand Thinning	This treatment includes steep areas which have low density and dominated by smaller trees or are in areas not conducive to cable yarding operations. Treatments where feasible would treat stand similar to the MSO PAC treatment described from above. Otherwise treatments would be thin from below to reduce density and fuel ladders.	202 – DLH
MSO Nest Fuels Reduction - Hand Thinning	Hand thinning up to 5" dbh would occur within 80 % of the Schultz Creek nest core in coordination with the US Fish and Wildlife Service (122 acres, DLH). Approximately 20% of the nest core would be deferred from treatment in order to maintain denser patches for habitat. Residual basal area would be a minimum of 110 ft2, and treatment would maintain a minimum of 60% canopy cover in mixed conifer. This nest core would also receive the prescribed burning treatment described below	122 – DLH

MSO Nest Fuels Reduction - Burn Only	In all nest cores other than the Schultz Creek nest core, treatment would consist of burning only. Dead and down material in MSO nest cores would be piled by hand and burned.	261 – DLH 402 – MM
MSO Recovery Nest/Roost - Hand Thinning	Hand thinning up to 9” dbh would occur on 72 acres in DLH under this treatment, and dead trees less than 12” dbh and down material would be cut and piled by hand for prescribed burning.	72 - DLH
MSO Recovery Nest/Roost - Burn Only	Thirty-seven acres of Recovery Nest/Roost replacement habitat would be prescribed burned only (no hand thinning). Snag retention guidelines identified in the Forest Plan would still be followed (see Design Features – Snags). Treatments would be designed to move the stands towards minimum desired conditions: Residual basal area of 110 ft2 in ponderosa pine, and 120 ft2 in mixed conifer; canopy cover of 40 percent in pine/pine-oak and 60 percent in mixed conifer; 12 trees per acre greater than 18” diameter; trees from 12-18” dbh would comprise over 30 percent of stands BA, and trees greater than 18 inches would comprise an additional 30% of BA.	37 - DLH
MSO Recovery Nest/Roost– Mechanical Thinning	Mechanical treatment would remove ponderosa pine in a variety of size classes however, no trees > 18” dbh would be cut. Treatments would be designed to maintain a minimum residual basal area of 110 ft2; canopy cover of 40 percent with 12 trees per acre greater than 18” diameter; trees from 12-18” dbh would comprise over 30 percent of stands BA, and trees greater than 18 inches would comprise an additional 30% of BA. No oak would be cut.	22 - MM
Northern Goshawk Post Fledging Areas (PFA) Fuels Reduction	Uneven-age mechanical treatment designed to develop uneven-aged structure and a mosaic of tree groups of varying sizes. Openings would occupy 20 percent of the treatment area. Tree groups would vary in shape, size, density, and number: generally from 0.05 – 0.7 acres in size with residual group basal areas of up to 30-90 ft2 per acre and 2-40 trees per group	359 - DLH

Northern Goshawk Nest Fuels Reduction	Mechanical treatment designed to develop northern goshawk nest stand conditions consisting of a contiguous over-story of large trees. Forest Plan guidelines for canopy cover would be met: canopy cover would vary from 50 to 70 percent.	100 - DLH
Aspen Treatment	A variety of different treatments would be used to promote and protect aspen health and regeneration, including the removal of post settlement conifers within 100 feet of aspen clones, prescribed fire, ripping, planting, fencing and/or cutting of aspen to stimulate root suckering.	22 – DLH
Grassland Restoration	Mechanical treatment to remove encroaching post-settlement conifers and restore the pre-settlement tree density and patterns.	60 – DLH
Burn Only	Burn only treatment would remove excessive fuel loading in areas which were previously burned by the Radio Fire.	270 - DLH
Electronic Site – Structure Protection	These sites are occupied by telecommunication facilities, and would be treated to provide a sufficient defensible space around these structures from a wildland fire. Individual trees that are determined to contribute to wildfire hazard or pose a hazard to the electronic sites would be removed. The remainder of the sites would receive a thin from below to approximately 20 – 40 ft2 basal area with the purpose of raising the crown base height and leaving the largest and most fire resistant trees.	6 – DLH 12 - MM
No Treatment (No New Analysis)	These acres include non-treatable areas, including rock faces and boulder fields, and the Orion Timber Sale (approximately 837 acres). Though the Timber Sale is within the project boundary, the treatments for that area were analyzed and authorized under the Jack Smith Schultz Fuels Reduction and Forest Health Restoration Project Decision Notice/Finding of No Significant Impact (2008). No additional treatments within the Timber Sale area are proposed under FWPP.	1605 - DLH

Table 17: Alternative 3 Harvesting Methods for DLH

Treatment Type	Ground-based	Hand Cut/Piled	Helicopter	Burn Only	Steep Slope Equipment	TOTAL
Ponderosa Pine Fuels Reduction	1613		242		10	**1865**
Ponderosa Pine Fuels Reduction – Hand Thinning		150				**150**
Mixed Conifer Fuels Reduction	626		425		107	**1158**
Mixed Conifer Fuels Reduction – Hand Thinning		85				**85**
MSO PAC Fuels Reduction	793		267		135	**1195**
MSO PAC Fuels Reduction – Hand Thinning		202				**202**
MSO Nest Fuels Reduction		122		261		**383**
MSO Nest/Roost Recovery		72		37		**109**
Goshawk PFA Fuels Reduction	299		39		21	**359**
Goshawk Nest Fuels Reduction	100					**100**
Aspen Treatment		22				**22**
Grassland Restoration	60					**60**
Burn Only				270		**270**
Electronic Site-Structure Protection	6					**6**
No Treatment/No New Analysis	**-**	**-**	**-**	**-**	**-**	**1605**
TOTAL	**3497**	**652**	**973**	**568**	**273**	**7569**

Table 18: Alternative 3 Harvesting Methods for MM

Treatment Type	Ground-based	Hand Cut/Piled	Burn Only	Steep Slope Machinery	TOTAL
Ponderosa Pine Fuels Reduction	766				**767**
MSO PAC Fuels Reduction	1519			73	**1592**
MSO PAC Fuels Reduction – Wet Mixed Conifer		180			**180**
MSO Nest Fuels Reduction			402		**402**
MSO Nest/Roost Recovery	22				**22**

Treatment Type	Ground-based	Hand Cut/Piled	Burn Only	Steep Slope Machinery	TOTAL
Electronic Site-Structure Protection	12				**12**
TOTAL	**2,320**	**180**	**402**	**73**	**2,975**

Required Transportation System

Alternative 3: Proposed Action without Cable Logging Proposed Transportation System

Under Alternative 3 the following actions would occur regarding road use, on the Dry Lake Hills and Mormon Mountain areas, respectively.

Dry Lake Hills

System haul roads within the project area	18.07miles
System haul roads outside the project area	14.33 miles
New temporary haul roads constructed	10.23 miles
Temporary roads on existing road prisms	2.75 miles
Temporary road rehabilitated	12.88 miles
Relocated system road used as haul road	1.57 miles
System road decommissioned	4.19 miles

Mormon Mountain

System haul roads within the project area	16.46 miles
System haul roads outside the project area	18.13 miles
New temporary haul roads constructed	0.0 miles
Temporary roads on existing road prisms	2.52 miles
Temporary road rehabilitated	2.52 miles
Relocated system road used for hauling	0.53 miles
System roads decommissioned	0.19 miles

Figure 32: Proposed Transportation System for Alternative 3, DLH

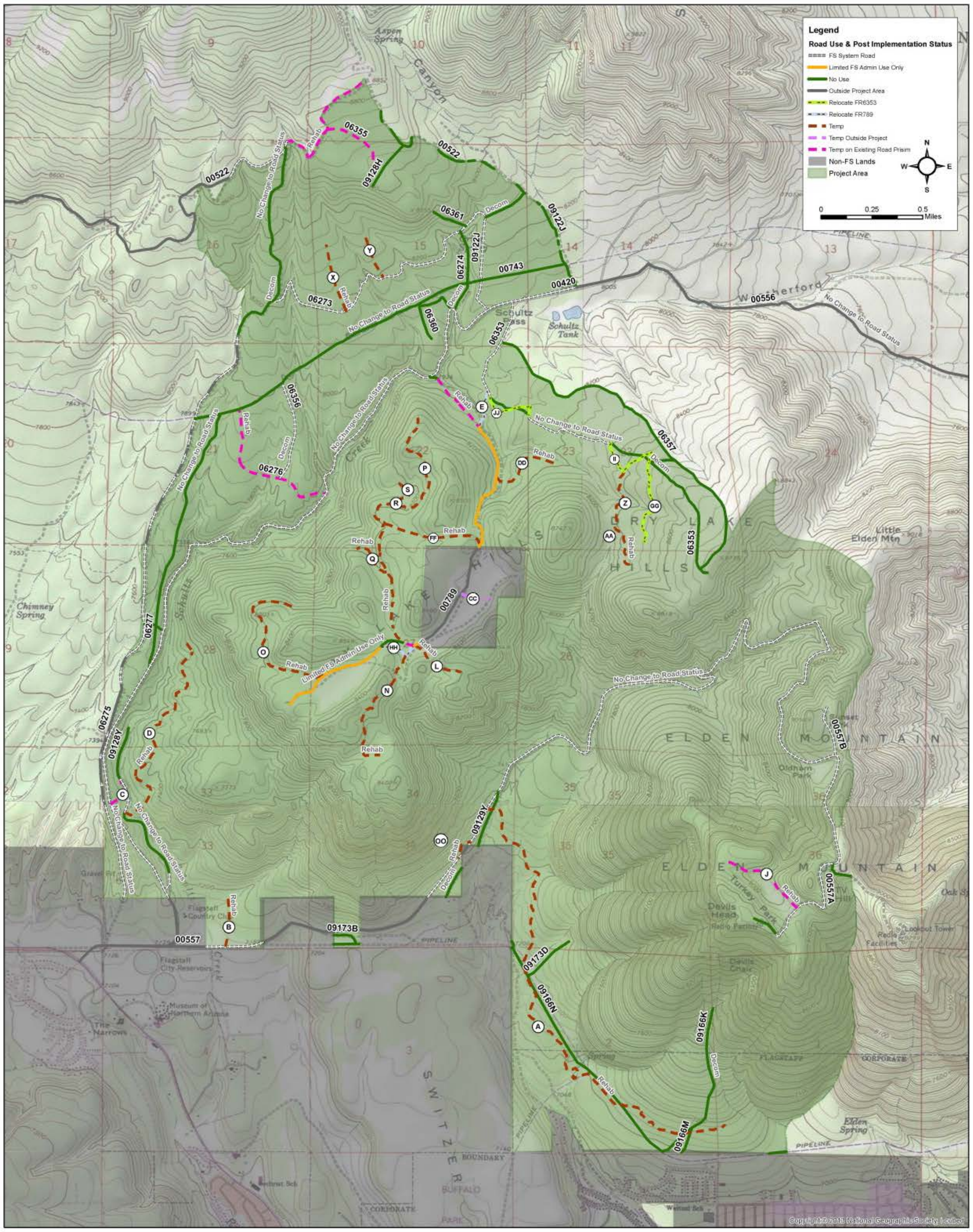
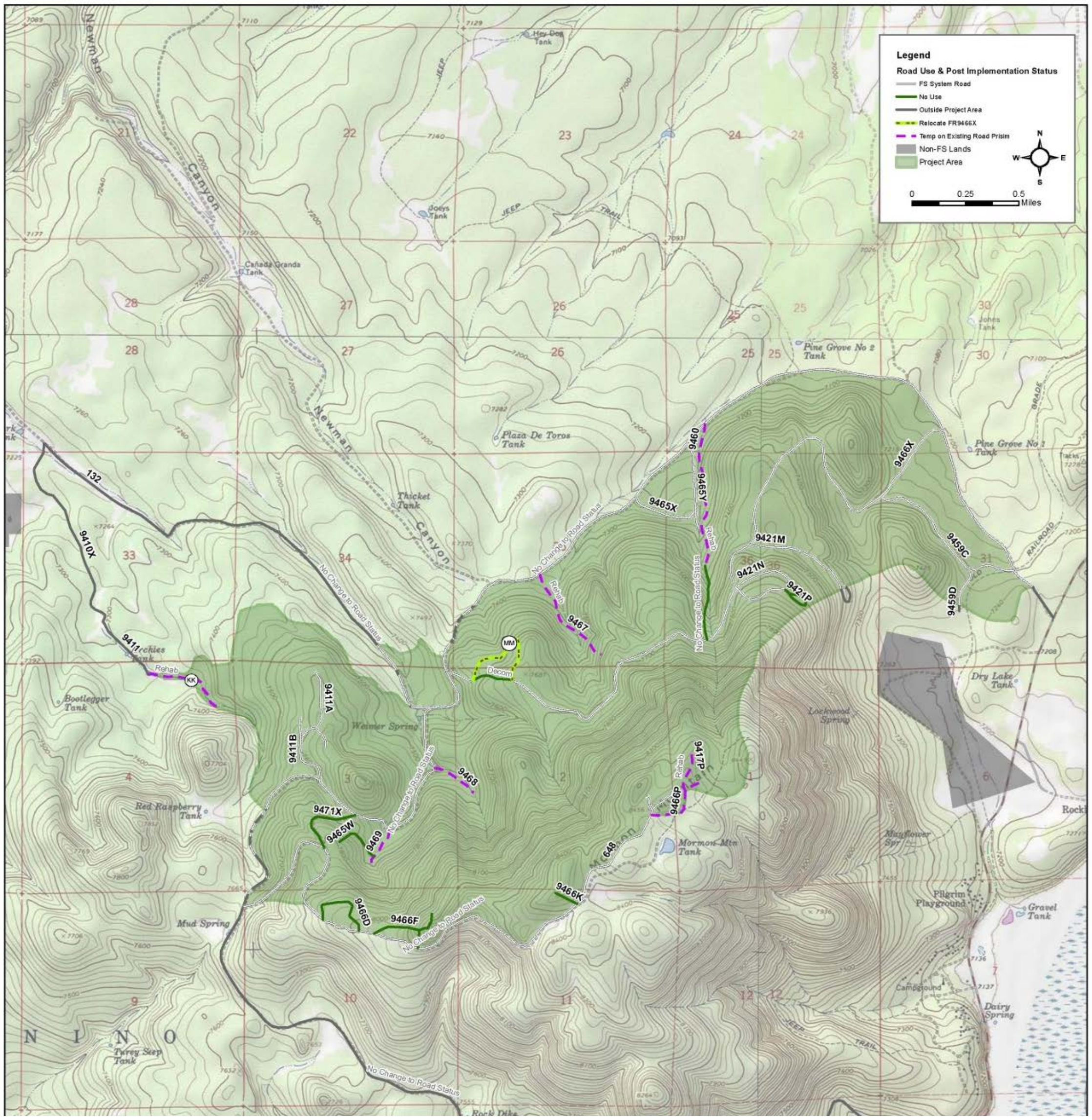


Figure 33: Proposed Transportation System for Alternative 3, MM



Alternative 4: Minimal Treatment Approach

This alternative would be similar to Alternatives 2 and 3; however the purpose of Alternative 4 is to implement the minimum amount of treatment necessary to meet the purpose and need. Treatments are proposed for those areas with dense fuel loading where topography aligns with dominant winds and the probability of severe effects to soil resources from a wildfire is greater, based on FLAM MAP 5.0 modeling of both fire behavior and fire spread under Schultz fire weather conditions. Specifically, factors considered include: fire hazard rating, potential damage to soils (from high severity fire and also harvesting methods), MSO habitat, and the type of harvesting methods necessary to affect change. Specific quantifiable metrics were not identified; instead the alternative was developed by identifying areas with dense fuel loading, where topography aligns with dominant winds, and the probability of severe effects to soil resources from a wildfire is greater, then overlaying those areas with sensitive wildlife habitat to determine where to propose treatments. Drivers are concerns about to minimize impacts to soils, wildlife, and recreation; to provide a full range of alternatives; and to refine and strategically place placements to treat the least amount of acreage necessary to still meet the purpose and need.

Under Alternative 4, approximately 3,459 acres along the base of Dry Lake Hills and Mount Elden and the upper, flatter tops would receive basically the same treatments proposed in Alternatives 2 and 3, though under this alternative more areas are proposed for hand thinning and prescribed burning instead of cable or helicopter logging in order to reduce the potential impacts from temporary road network associated with those harvesting methods (roughly 46 percent of the DLH project area). Additionally, treatments are focused on the area south and east of FR420 (Figure 34); the portion of the project area between FR420 and the Kachina Peaks Wilderness would still be treated but under the constraints of the analysis and decision for the Jack Smith Schultz Fuels Reduction and Forest Health Restoration Project. Thus, no new analysis would be performed for those areas under this alternative.

The Spruce Avenue Wash was identified as a high priority area due to the fuel loading, topography, size and also its location relative to the City of Flagstaff and MSO PACs. The portion of the Mount Elden MSO PAC within the Spruce Avenue Wash would also be treated under the same parameters described in Alternatives 2 and 3. The Schultz Creek MSO PAC and nest core were identified in conjunction with the FWS as high priority areas, and would also receive the same treatment described for Alternatives 2 and 3.

For MM, treatments would occur on 2,343 acres (Figure 35). The same methodology used for treatment placements in the DLH area was applied to MM to determine where to focus treatments. Under Alternative 4, the wet mixed conifer belt and MSO nest cores would not be treated, (roughly 21 percent of the MM area); however treatments would occur below and above that belt.

Areas not included in this alternative would be designated as No Treatment. Using hand thinning on steep slopes was not included in Alternative 4 due to: the preponderance of trees greater than 9 inches dbh, (the standard limit for hand thinning treatments), the safety concerns of hand felling larger trees on steep rocky slopes, the inability to remove cut material which would leave an overabundance of fuels on the ground, and the subsequent need for extensive hand piling and burning on steep slopes.

All treated acres would include prescribed burning in the manner described under Alternative 2: initially pile burning to remove slash accumulated through harvesting, followed by broadcast burning. Maintenance burning may occur every five to seven years following implementation in order to maintain lower fuel loading levels and to restore a frequent, low-severity fire regime. Mixed conifer on steep slopes may only receive one broadcast burn through the life of the project due to the difficulty of implementation in these fuel types and terrain, and also because the historic Fire Return Interval in some vegetation types is historically longer than the life of this project. Other slash removal options as described in the Implementation Methods section could also be used in lieu of burning, including biomass removal.

Figure 34: Alternative 4 Proposed Treatments, DLH

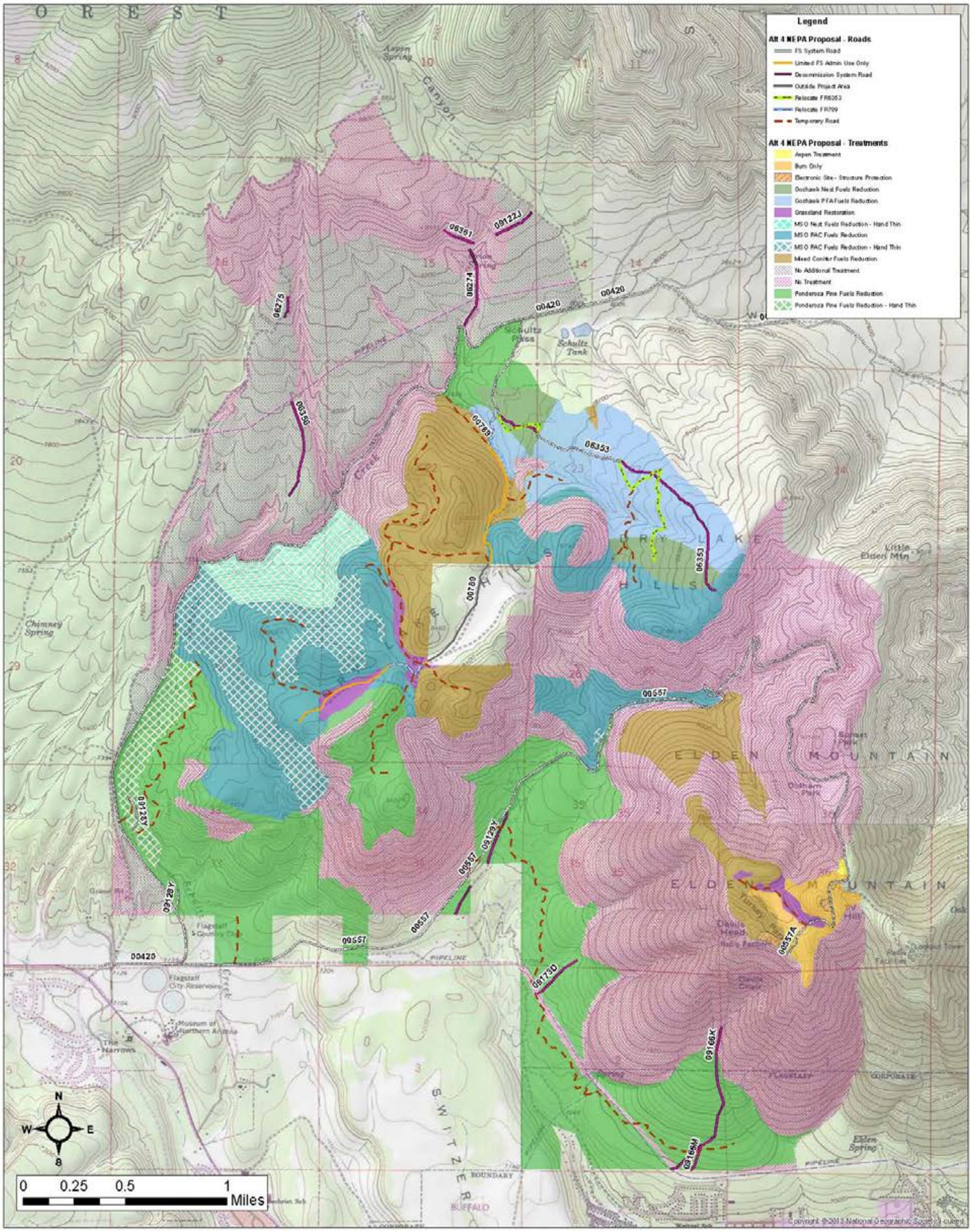


Figure 35: Alternative 4 Proposed Treatments, MM

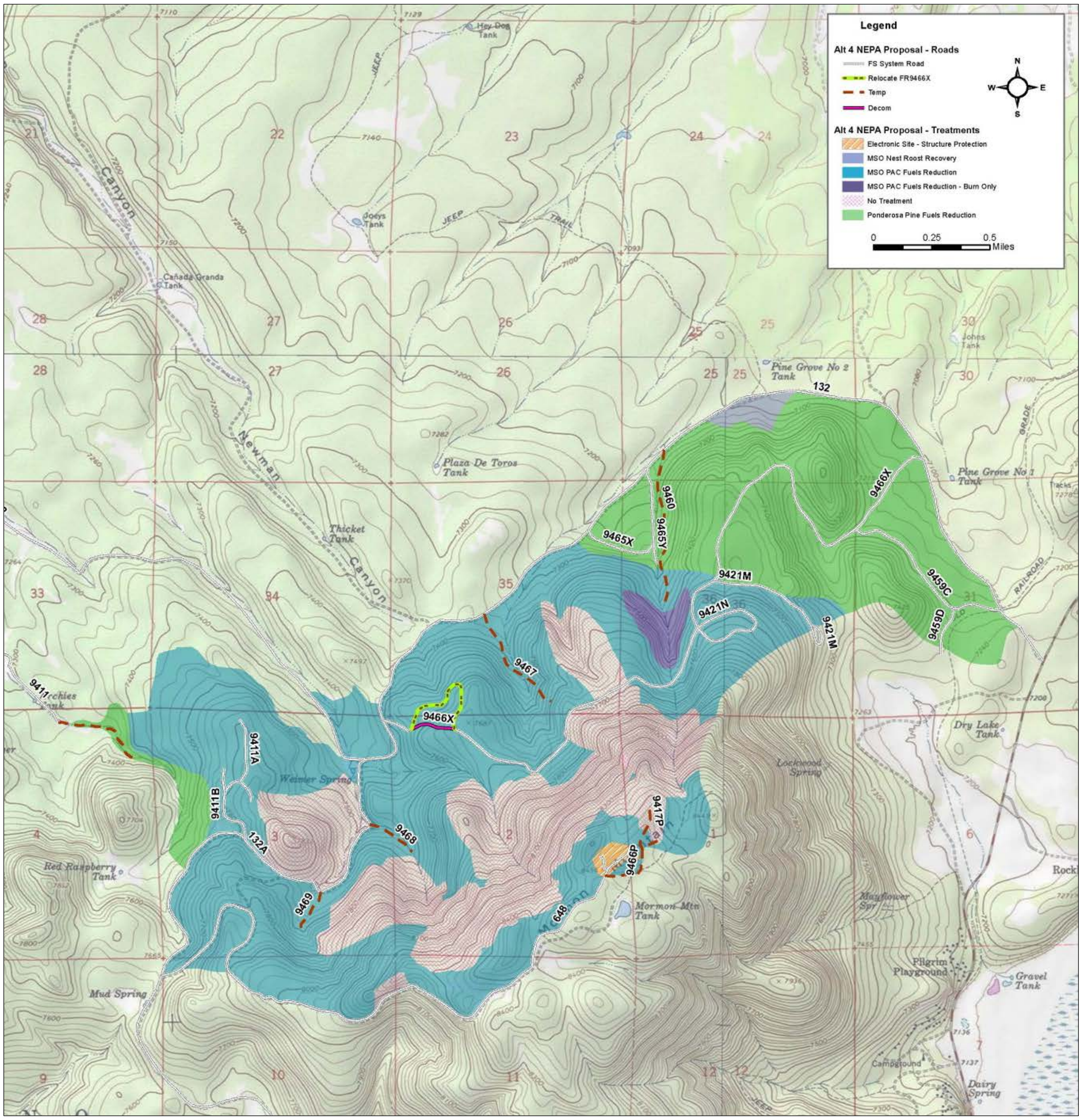


Table 19: Alternative 4 Proposed Treatment Descriptions, Objectives and Acres

Treatment Type	Treatment Description/Objective	Acres
Ponderosa Pine Fuels Reduction (Northern Goshawk LOPFA Areas)	These treatments areas are outside of MSO PACs and northern goshawk PFAs and nest cores. Mechanical treatment designed to develop uneven-aged structure and a mosaic of openings and tree groups of varying sizes.	1400– Dry Lake Hills (DLH) 766– Mormon Mountain (MM)

Treatment Type	Treatment Description/Objective	Acres
	Openings would occupy approximately 20 percent of the treatment area. Tree groups would vary in shape, size, density, and number: generally from 0.05 – 0.7 acres in size with residual group basal areas of 20-80 ft2 per acre and 2-40 trees per group.	
Ponderosa Pine Fuels Reduction – Hand Thinning (Northern Goshawk LOPFA Areas)	This treatment includes steep areas that have low tree density and/or are dominated by smaller diameter trees where the purpose and need can be met through hand felling treatments. Where practical and feasible, treatments would be designed to develop uneven-aged structure and a mosaic of tree groups of varying sizes similar to the treatment described above.	86- DLH
Mixed Conifer Fuels Reduction (MSO Recovery Areas)	These treatments areas include dry mixed conifer areas outside of MSO PACs, replacement nest/roost habitat, and northern goshawk PFAs and nest cores, but include MSO restricted habitat. Mechanical treatment designed to develop uneven-aged structure and a mosaic of openings and tree groups of varying sizes. Trees above 24” dbh would not be cut. Openings would occupy about 10-20 percent of the treatment area. Tree groups would vary in shape, size, density, and number: generally less than one acres in size with residual group basal areas of 30-90 ft2 per acre and 2-50 trees per group	542- DLH
MSO PAC Fuels Reduction	Mechanical treatment to create a diversity of patch sizes with minimum patch size of 2.5 acres. Provide for 10 percent openings across treatment areas from 0.1 – 2.5 acres in size. Maintain a minimum of 40 percent canopy cover in pine/pine-oak and 60 percent in mixed conifer. Post-treatment, trees greater than 16” dbh would contribute at least 50 percent of the stand basal area per MSO Recovery Plan guidelines (2012). Trees above 18” dbh would not be cut except if necessary for cable corridor locations.	568– DLH 1509- MM[15]
MSO PAC Fuels Reduction – Hand Thinning	This treatment includes steep areas which have low density and dominated by smaller trees. Treatments where feasible would treat	228– DLH

[15] Thirty-three acres within MSO PACs on MM are included in the Burn Only treatment description, and would not receive mechanical thinning. Those acres are shown in the Burn Only treatment acres, and are not counted toward the total displayed for MSO PAC Fuels Reduction here.

Treatment Type	Treatment Description/Objective	Acres
	stand similar to the MSO PAC treatment described from above. Otherwise treatments would be thin from below to reduce density and fuel ladders.	
MSO Nest Fuels Reduction	Hand thinning up to 5" dbh and prescribed burning would occur within 80% the Schultz Creek nest core in coordination with the US Fish and Wildlife Service (122 acres, DLH). Dead and down material in the Schultz Creek nest core would also be piled by hand and burned.	122– DLH
MSO Recovery Nest/Roost - Mechanical Thinning	Mechanical treatment would remove ponderosa pine in a variety of size classes however, no trees > 18" dbh would be cut. Treatments would be designed to maintain a minimum residual basal area of 110 ft2; canopy cover of 40 percent with 12 trees per acre greater than 18" diameter; trees from 12-18" dbh would comprise over 30 percent of stands BA, and trees greater than 18 inches would comprise an additional 30% of BA. No oak would be cut.	22 - MM
Northern Goshawk Post Fledging Areas (PFA) Fuels Reduction	Uneven-age mechanical treatment designed to develop uneven-aged structure and a mosaic of tree groups of varying sizes. Openings would occupy 20 percent of the treatment area. Tree groups would vary in shape, size, density, and number: generally from 0.05 – 0.7 acres in size with residual group basal areas of up to 30-90 ft2 per acre and 2-40 trees per group	286- DLH
Northern Goshawk Nest Fuels Reduction	Mechanical treatment designed to develop northern goshawk nest stand conditions consisting of a contiguous over-story of large trees. Forest Plan guidelines for canopy cover would be met: canopy cover would vary from 50 to 70 percent.	100- DLH
Aspen Treatment	A variety of different treatments would be used to promote and protect aspen health and regeneration, including the removal of post settlement conifers within 100 feet of aspen clones, prescribed fire, ripping, planting, fencing and/or cutting of aspen to stimulate root suckering.	2– DLH
Grassland Restoration	Mechanical treatment to remove encroaching post-settlement conifers and restore the pre-settlement tree density and patterns.	53– DLH

Treatment Type	Treatment Description/Objective	Acres
Burn Only	Burn only treatment in the Dry Lake Hills would remove excessive fuel loading in areas which were previously burned by the Radio Fire. Thirty-three acres within MSO PACs on Mormon Mountain would be burn only, and would not receive mechanical treatment.	67- DLH 33 - MM
Electronic Site – Structure Protection	These sites are occupied by telecommunication facilities, and would be treated to provide a sufficient defensible space around these structures from a wildland fire. Individual trees that are determined to contribute to wildfire hazard or pose a hazard to the electronic sites would be removed. The remainder of the sites would receive a thin from below to approximately 20 – 40 ft2 basal area with the purpose of raising the crown base height and leaving the largest and most fire resistant trees.	6– DLH 12- MM
No Treatment (No New Analysis)	These acres include rock faces, boulder fields, some steep slopes requiring specialized equipment, and all acres north of FR420 (including the Orion Timber Sale), as those acres have already been analyzed for treatment under the Jack Smith Schultz Fuels Reduction and Forest Health Restoration Project Decision Notice/Finding of No Significant Impact (2008).	4110- DLH 631 - MM

Table 20: Alternative 4 Harvesting Methods for DLH

Treatment Type	**Ground-based**	**Hand Cut/Piled**	**Burn Only**	**TOTAL**
Ponderosa Pine Fuels Reduction	**1400**			**1400**
Ponderosa Pine Fuels Reduction – Hand Thinning		**86**		**86**
Mixed Conifer Fuels Reduction	**542**			**542**
MSO PAC Fuels Reduction	**568**			**568**
MSO PAC Fuels Reduction – Hand Thinning		**228**		**228**
MSO Nest Fuels Reduction		**122**		**122**
Goshawk PFA	**286**			**286**

Treatment Type	Ground-based	Hand Cut/Piled	Burn Only	TOTAL
Fuels Reduction				
Goshawk Nest Fuels Reduction	**100**			**100**
Aspen Treatment		**2**		**2**
Grassland Restoration	**53**			**53**
Burn Only			**67**	**67**
Electronic Site-Structure Protection	**6**			**6**
No Treatment	**-**	**-**	**-**	**4110**
TOTAL	**2,953**	**438**	**67**	**7569**

Table 21: Alternative 4 Harvesting Methods for MM

Treatment Type	Ground-based	Burn Only	TOTAL
Ponderosa Pine Fuels Reduction	766		766
MSO PAC Fuels Reduction	1509		1509
MSO PAC Fuels Reduction – Burn Only		33	33
MSO Nest/Roost Recovery	22		22
Electronic Site-Structure Protection	12		12
No Treatment	-	-	631
TOTAL	**2310**	**33**	**2,975**

Large Tree Retention Strategy

Alternative 4 incorporates the goal of retaining large young trees and old trees within the project area brought forth as the Large Tree Retention Strategy (LTRS) by the Center for Biological Diversity during the scoping period. However the decision-making authority of the Forest Service would not be delegated. The incorporation of the LTRS goals is accomplished in Alternative 4 primarily by excluding the use of cable logging and specialized steep slope equipment within the project area. Those two harvesting methods would require the removal of either a) all trees within a 12-foot swath, as in the case of the cable corridors, or b) more large trees on steep slopes for maneuverability and/or safety.

The original LTRS provided by the Center for Biological Diversity was not included in its entirety in this alternative as all the action alternatives incorporate the large majority of the ecological principles and concepts in the strategy already, including retention of old trees (see Design Features in Chapter 2). The original LTRS provided during the scoping period is included in the project record. Large post-settlement trees would be retained throughout the project area except:

1. As necessary to meet community protection and public safety goals (e.g. in WUI areas adjacent to communities)

2. When best available science identifies sites where ecological restoration and biodiversity objectives cannot otherwise be met; specifically in the case of FWPP, within stand openings and in heavily-stocked stand with high basal area generated by a preponderance of large, young trees.

Per the two points above, the modified LTRS discussed here would only potentially apply to a small portion of the project area – approximately 766 acres of ponderosa pine in the MM portion—as the DLH portion would fall under the first point noted above. The original LTRS was developed specifically for ponderosa pine and so does not apply to mixed conifer areas. As the MM portion does not fit within Number 1 above because of its distance from the City of Flagstaff, the rest of the LTRS will only pertain to the ponderosa pine Gambel oak forests outside of MSO PACs on MM.

Most of the “exception” categories listed in the LTRS are not relevant for the MM portion of FWPP discussed above, including:

- Seeps and Springs
- Riparian
- Wet Meadows
- Encroached Grasslands
- Aspen Forest and Woodland

As not every acre of the relevant MM portion was surveyed (see Methodology section of Forest Structure and Health in Chapter 3), it is possible that the 766 acres of ponderosa pine might primarily contain small-diameter (less than 16 inches dbh) trees, which would not fit within an exception category under the original LTRS. As stated in the Forest Structure and Health methodology section:

> The modeling assumptions attempt to meet the spirit of the Large Tree Retention Strategy (LTRS) within the limitations of a non-spatially explicit model. On the ground cutting prescriptions for Alternatives 2 and 3 would follow components of the LTRS that have been incorporated into the design features of this EIS. Alternative 4 would include more specific limitations on large tree removal per the modified LTRS and related Design Features discussed in this DEIS (p. 198)

Because of this, as long as the purpose and need of fire hazard reduction would still be met, Alternative 4 would incorporate the following additional Design Features for the Northern Goshawk habitat within LOPFA on MM:

- To meet the desired condition of increasing the more fire-resilient VSS 5 and 6 age class, tree retention within groups would focus on existing large trees (generally, trees within the dominate and codominant crown position).

- Tree groups, on average, would range in size from 0.1 to 1 acre; sites with a preponderance of large trees and highly productive microsites would have larger average group sizes (0.25 to 1 acre). Overall, average group size would vary within this range depending on fuel loading, site quality and topography, existing stand structure, and pre-settlement tree evidence.

- Stands with a preponderance of large trees would be managed for greater residual canopy cover and density of large young trees while still meeting the purpose and need of reduced wildfire hazard. Residual stand structure would be managed toward the upper end of natural range of variability for ponderosa pine in the stands that meet these conditions (e.g. the number of trees retained would be toward the higher end of the scale; see Table 22). This would be accomplished by focusing treatments towards the higher end of the natural range of variability, managing for larger group sizes (see below), and/or retaining additional large trees.

- Regeneration openings (group selection) account for 10 to 20 percent of tree groups. The percentage would vary within this range depending on current VSS distribution. They would average 0.25 to 2 acres with an average of approximately 1 acre and would be no wider than 200 feet. Where stand structure dictates, establish regeneration openings by removing groups of trees of VSS3 and smaller diameter VSS4.

Table 22: Ranges of reference conditions for ponderosa pine forests in the Southwestern United States from studies detailed in RMRS-GTR-310 (2013).

Forest attribute	Ponderosa pine
Trees / acre	11.7-124
Basal area (ft2 / acre)	22.1-89.3
Spatial patterns	Grouped or random
Number of trees / group	2-72
Size of groups (acres)	0.003-0.72
Number of groups / acre	6-7

Forest Plan Amendments

Alternative 4 would contain Forest Plan Amendments 1 and 2 (described under Alternative 2 and in Appendix A) because these Forest Plan amendments would be necessary to meet the purpose and need of the project to effectively reduce the potential for high-severity wildfire within the project and analysis area.

Required Transportation System

Alternative 4: Minimal Treatment Proposed Transportation System

Under Alternative 4 the following actions would occur regarding road use on the Dry Lake Hills and Mormon Mountain Areas, respectively. Alternative 4 differs from Alternatives 2 and 3 in that there would be no hauling on FR 522 and FR 516 (Snowbowl road), and also includes fewer temp roads than the other two action alternatives (12.71 miles versus 20.98 miles and 15.17 miles for Alternatives 2 and 3, respectively).

Dry Lake Hills

System haul roads within the project area	13.04 miles
System haul roads outside the project area	7.37 miles
New temporary haul roads constructed	9.42 miles
Temporary roads on existing road prisms	0.99 miles
Temporary road rehabilitated	10.41 miles
Relocated system road used as haul road	1.57 miles
System road decommissioned	4.19 miles

Mormon Mountain

System haul roads within the project area	16.46 miles

System haul roads outside the project area	18.13 miles
New temporary haul roads constructed	0 miles
Temporary roads on existing road prisms	2.52 miles
Temporary road rehabilitated	2.52 miles
Relocated system road used for hauling	0.53 miles
System roads decommissioned	0.19 miles

Figure 36: Proposed Transportation System for Alternative 4, DLH

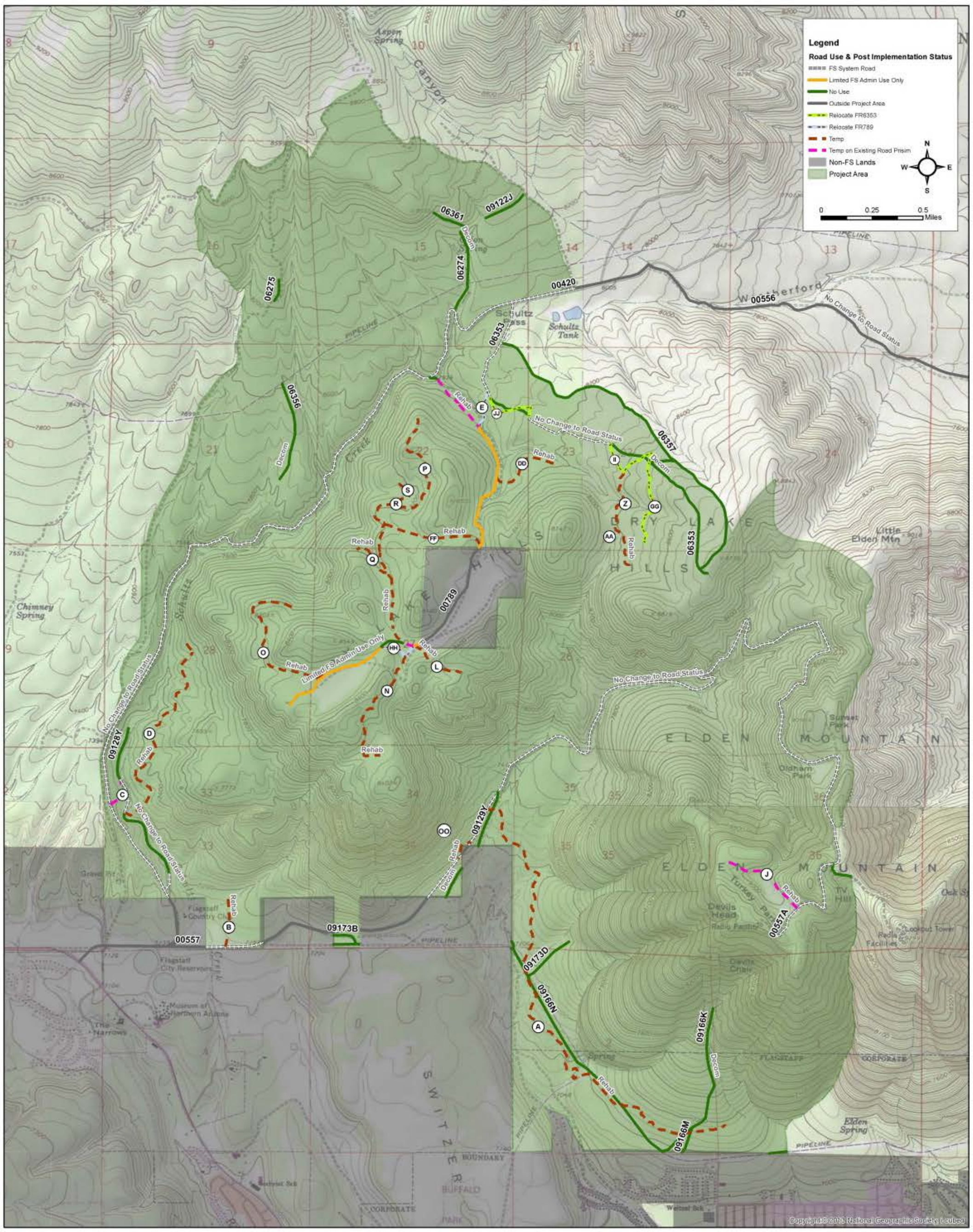
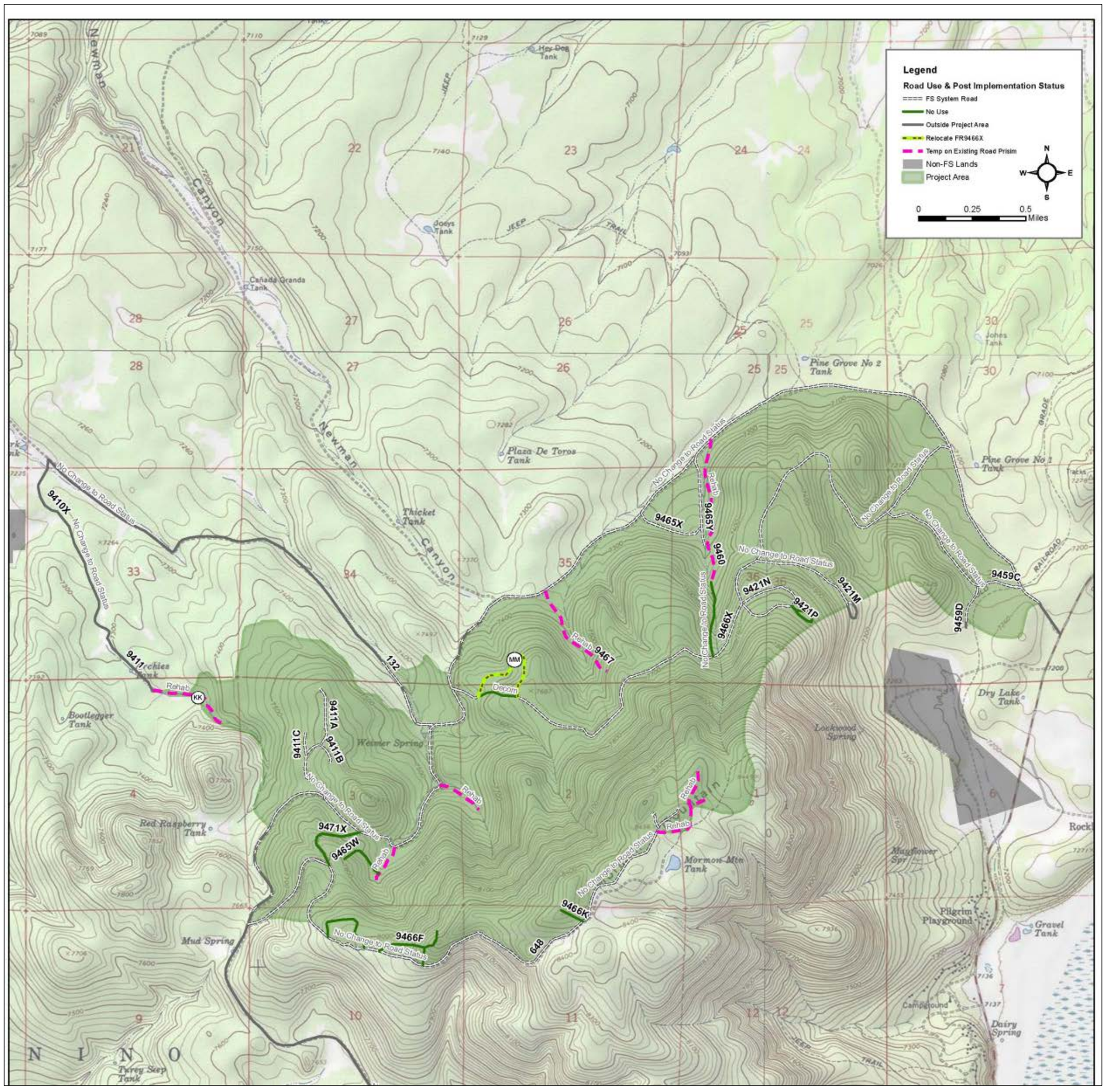


Figure 37: Proposed Transportation System for Alternative 4, MM



Restoration versus Fire Hazard Reduction

Fuels reduction treatments can also be considered restoration, and while FWPP is distinguished as a “fire hazard reduction” project instead of strictly a restoration project, multiple ecological restoration benefits would be achieved through forest thinning, including but not limited to benefits to biodiversity and increased forest resilience to drought, insects and disease. Where restoration is the focus it is valuable to note that these treatments will reduce the fire hazard (Friederici 2003 and Fulé et al. 2012). Table 23 shows the proposed treatments and whether they fit under the umbrella of restoration, or if they’re more aimed toward fire-hazard reduction. In some cases, the fire-hazard reduction treatments would result in denser forest conditions than a restoration approach; this is tied to fire regimes, wildlife habitat limitations, and also the influence of the wildand-urban interface and the project’s purpose and need.

The fire regime for dry mixed conifer is very similar to that of ponderosa pine, the fire regimes of wet mixed conifer involves less frequent, higher-severity fires than what is desirable for protection of soil resources and the adjacent urban interface. Thus, for those areas, the proposed treatment approach is more geared toward fire hazard reduction than true restoration.

A large portion of the project area falls within MSO habitat; management of those areas is guided by the Recovery Plan, and as such, the desired conditions may generally be denser (i.e. higher canopy cover, higher basal area) than what may have been present in mixed conifer historically. Therefore the proposed treatments would achieve the purpose and need of reducing the potential of high-severity wildfire even though they might not meet full restoration conditions.

The mixed conifer treatments proposed under the action alternatives for FWPP could very well be similar to historical conditions in each of those locations; however due to the reasons cited above, restoration is only cited as such in the treatments below when that approach also met the purpose and need for the project.

Table 23: Proposed Treatments and their focus (restoration or fire hazard reduction)

Treatment:	Focus:	Effect of focus:
Aspen Treatment	Restoration	Restoring aspen stands achieves fire hazard reduction and desired condition.
Burn Only	Fire Hazard Reduction	Prescribed burning would reduce fire hazard and moves towards desired condition but would not necessarily achieve restoration objectives.
Electronic Site - Structure Protection	Fire Hazard Reduction	These are highly developed and managed sites and restoration to historical tree densities and patterns is not desirable or practical. Treatments in this area would likely remove more understory, small diameter trees and reflect conditions that likely do not historically occur.
Northern Goshawk Nest Fuels Reduction	Restoration	Treatment would be designed to create habitat for northern goshawk nests, Tree density would be similar but denser than historic conditions, and tree size distribution and spatial arrangement would not follow historic

Treatment:	Focus:	Effect of focus:
		patterns.
Northern Goshawk Post Fledging Areas (PFA) Fuels Reduction	Restoration	Treatment would move stands towards sustainable uneven-aged conditions and spatial arrangements, which would be within the natural range of variability for this forest type. Treatment would also meet fire hazard reduction objectives and desired condition.
Grassland Restoration	Restoration	Restoration of historic grassland extent would also meet fuels reduction objectives and desired conditions.
Mixed Conifer Fuels Reduction	Restoration	Treatment would move stands towards sustainable uneven-aged conditions and spatial arrangements which would be similar to and within the natural range of variability for this forest type. Treatment would also meet fire hazard reduction objectives.
Mixed Conifer Fuels Reduction - Hand Thin	Fire Hazard Reduction	Treatment would reduce fire hazard and would move stands towards but not meet desired conditions. Tree densities would be higher than historic levels and spatial patterns would not mimic historic patterns.
MSO Nest Fuels Reduction - Burn Only	Fire Hazard Reduction	Prescribed burning would reduce fire hazard and thus move toward desired conditions, but would not necessarily achieve restoration objectives.
MSO Nest Fuels Reduction - Hand Thin	Fire Hazard Reduction	Treatment would reduce fire hazard. Tree densities would be higher than historic levels and spatial patterns would not mimic historic patterns.
MSO Nest Roost Recovery – Burn Only	Fire Hazard Reduction	Prescribed burning would reduce fire hazard but would not necessarily achieve restoration objectives.
MSO Nest Roost Recovery	Fire Hazard Reduction	Treatment would reduce fire hazard. Tree densities would be higher than historic levels and spatial patterns would not mimic historic patterns.
MSO PAC Fuels Reduction	Fire Hazard Reduction	Treatment would move stands towards uneven-aged conditions and spatial arrangements. Conditions would be much denser than historical conditions. Treatment would reduce fire hazard.
MSO PAC Fuels Reduction - Hand Thin	Fire Hazard Reduction	Treatment would reduce fire hazard and would move stands towards but not meet desired conditions. Tree densities would be higher than historic levels and spatial patterns would not mimic

Treatment:	Focus:	Effect of focus:
		historic patterns.
MSO PAC Fuels Reduction – Wet Mixed Conifer	Fire Hazard Reduction	Treatments would regenerate patches of aspen which would reduce fire hazard and achieve limited restoration objectives.
Ponderosa Pine Fuels Reduction	Restoration	Treatment would move stands towards sustainable uneven-aged conditions and spatial arrangements, which would be similar to and within the natural range of variability for this forest type. Treatment would meet fire hazard reduction objectives and desired conditions.
Ponderosa Pine Fuels Reduction - Hand Thin	Fire Hazard Reduction	Treatment would reduce fire hazard and would move stands towards but not meet desired conditions. Tree densities would be higher than historic levels and spatial patterns would not mimic historic patterns.

Design Features Common to All Alternatives

The Forest Service also developed the following design features to be used as part of all of the action alternatives. These design features include all best management practices (BMPs) related to the proposed alternatives.

Table 24: Design Features Common to all Action Alternatives

Specialist Area	Related Resource	Design Feature
Silviculture	Old Trees	Emphasize retaining old, pre-settlement trees where possible, particularly within MSO recovery nest/roost habitat. Old trees, as defined by Thomson (1940) for ponderosa pine, and mixed conifer species with fire scars would not be targeted for cutting. However, exceptions may be necessary. An example of this would be removing an old tree to address human health and safety concerns and OSHA regulations where treatments are occurring if these trees are considered to be dangerous. Another instance would be to cut an old tree in order to accommodate the turning radius of a logging truck, rather than relocating an entire road, or if they are located within a cable yarding corridor or temporary road location.
	Large Trees	Post-settlement ponderosa pine trees > 16 inches dbh would be prioritized for protection, but may be removed to restore forest health and to

Specialist Area	Related Resource	Design Feature
		emulate natural vegetation patterns based on current stand conditions, pre-settlement evidences, desired future conditions, or other restoration objectives. Instances where this would occur include: in conifer-encroached aspen stands, encroached grasslands, in heavily stocked stands of large, young trees when the presence of such trees would prevent the re-establishment of sufficient stand openings, when necessary to develop or maintain uneven-aged forest conditions (where desired), and if they are located within a cable yarding corridor or temporary road location.
	Mixed Conifer	Treatments within both dry and wet mixed conifer vegetation types would be site-specific in nature and vary according to the diversity of tree species compositions and locations.
	Juniper & Gambel Oak	• Gambel oak would only be cut as necessary to facilitate logging operations (skid trail and landings). • Large mature juniper ("alligator juniper") and pinyon species would not be cut as part of treatments. Young and mid-aged juniper and pinyon may be cut to reduce fire risk to surrounding larger trees. • Placement of roads, skid trails and landings would avoid cutting or damaging large alligator junipers and gambel oak where possible.
	Forest Health	Log decks would not be left at the landings or in the treatment areas for such a period that would contribute to an increase in bark beetle populations; typically no longer than 4 weeks if bark beetles are present. Logs and log decks could be left for longer than 4 weeks if no bark beetle activity is detected. Entomologists from the Forest Health Group would be consulted as needed.
Operations	Operational Safety	Danger trees that are present within two tree-lengths of areas where contractors are not enclosed within a Falling Object Protective Structure (FOPS) cab may be removed or felled. These areas include cutting units that require manual falling, cable or helicopter logging units and landings. A danger tree is any tree that presents a hazard to employees due to conditions such as deterioration or damage to the root system, trunk, stem or limbs

Specialist Area	Related Resource	Design Feature
	Coordination	Use of haul routes designated either within or adjacent to utility corridors would be coordinated with Kinder Morgan Natural Gas Company, the City of Flagstaff Water Utility Division, and/or other appropriate utility companies.
Fire/Fuels	Slash Mats	In areas where slash mats are used to protect soils during harvesting activities, Forest Service fire/fuels personnel would work with the appropriate contract authority to determine if material should be piled and burned post-implementation where slash exceeds 4 inches in depth.
	Fuelwood Gathering	Areas of project-generated slash suitable for fuelwood gathering (outside of MSO PACs, recovery habitat and northern goshawk PFAs) could be identified for public use. Those areas would be identified on the Forest website and on the map accompanying each fuelwood gathering permit.
	Slash Treatment	• Limit machine piling of slash within 300 feet of private property boundaries. • Limit hand piling within 50 feet of private property boundaries. • If a market for biomass exists during the time of implementation, biomass removal methods may be utilized in place of pile burning in areas identified for potential ground based harvesting, particularly in areas adjacent to residential property.
Heritage	Site Protection	• All fire intolerant sites would be marked for avoidance from prescribed burning and all National Register of Historic Places (NRHP) eligible or unevaluated sites would be protected from ground disturbing activities. • No mechanized thinning would occur within NRHP eligible sites; however hand thinning could occur. These efforts would be coordinated by the District Archaeologist.
	Survey	Temporary roads would be surveyed prior to their construction per the sampling plan submitted and approved by the State Historic Preservation Office (SHPO).
Wildlife	Mexican Spotted Owl	• MSO surveys would be coordinated with the Fish and Wildlife Service the year of implementation or one year prior to determine occupancy of owls. Surveys

Specialist Area	Related Resource	Design Feature
		include the project area plus ½ mile beyond the perimeter of the project boundary. • The FWPP project boundary lies within the project boundary for 4FRI as well as other forest thinning and burning projects. Flagstaff Ranger District staff would ensure that all proposed treatments are coordinated to ensure that there are not multiple entries into sensitive habitats (such as MSO PACs) that are split between different project boundaries. In doing so, habitat and noise disturbance to these areas would be minimized. • The Forest Service would monitor effects to MSO from the proposed action and report their findings to the FWS. Implementation monitoring would include information such as when or if the project was implemented, whether the project was implemented as analyzed in the site specific BO (including conservation measures, and best management practices), breeding season(s) over which the project occurred, relevant MSO survey information, and any other pertinent information about the project's effects on the species. Treatment activities within PACs would be assessed through implementation of the monitoring plan designed with FWS. • Treatments would be designed so that thinning activities within each PAC would be completed in one to two breeding seasons. Treatments within MSO PACs may occur during the breeding season for no more than two years; if implementation is not completed at the end of two years, timing restrictions would apply (March 1 – August 31). The Thicket northern goshawk PFA on Mormon Mountain would be treated in conjunction with the PACs it overlaps with the same parameters. • Activities would not occur within MSO occupied nest cores during the breeding season (March 1 – August 31). • Initial entry burning and pile burning would primarily occur in PACs during the fall/winter to minimize impacts from smoke on MSO. Maintenance burning within PACs

Specialist Area	Related Resource	Design Feature
		but outside of nest cores could occur during the breeding season. • Prescribed fire would be allowed to enter cores only if it is expected to burn with low fire severity and intensity. Firelines, check-lines, backfiring, and similar fire management tactics would be used to reduce fire effects and to maintain key habitat elements (e.g. hardwoods, large downed logs, snags, and large trees). • In MSO recovery habitat, manage for large oaks by removing conifers up to 18 inches dbh that do not meet the "old tree" definition within 30 feet of oak 10 inches drc or larger • Coordinate burning spatially and temporally to limit smoke impacts to nesting owls (March 1 to August 31). • The Forest Service, in coordination with the FWS, shall develop contingency plans in the event of new PACs being established or PAC boundary modifications due to owl movement or habitat changes. Flexibility shall be built into the project (including task orders) so that as owls move or new sites are located, project activities can be modified to accommodate these situations. Minor modifications will be coordinated with FWS. • The Forest Service shall ensure that all contractors associated with thinning and burning activities, transportation of equipment and forest products, research, or restoration activities are briefed on the Mexican spotted owl, know to report sightings and to whom, avoid harassment of the owl, and are informed as to who to contact and what to do if a Mexican spotted owl is incidentally injured, killed, or found injured or dead on the Coconino NF. If an owl fatality is discovered, the FWS Mexican spotted owl lead will be contacted as soon as possible. • The Forest Service shall meet annually with the FWS to discuss the upcoming year's thinning and burning plans in Mexican spotted owl habitat and review the past year's thinning and burning activities in owl

Specialist Area	Related Resource	Design Feature
		habitats.
	Northern Goshawk	• Thinning treatments within PFAs may occur during the northern goshawk breeding season for no more than two years; if implementation is not completed at the end of two years, timing restrictions would apply (March 1 – September 30). The Thicket northern goshawk PFA on Mormon Mountain would be treated in conjunction with the PACs it overlaps with the same parameters as those PACs. • Prescribed burn plans in northern goshawk PFAs would be designed and implemented to minimize smoke impacts to nesting birds and minimize loss of nest trees.
Wildlife	Other Wildlife	• No thinning activities would occur within one-quarter mile of the Devil's Head peregrine eyrie if occupied during the breeding season (March 1 – August 15). • If any of the three bald eagle nests near Mormon Mountain are occupied during the eagle breeding season (March 1- August 1), prescribed burning would only be permitted in the Mormon Mountain project area when ventilation is favorable and in coordination with the wildlife biologist and FWS. Typically nesting status can be confirmed by May. • Burn plans within 1/2 mile of golden eagle nest and peregrine falcon eyries would be coordinated with the district wildlife biologist to insure nesting falcons and golden eagles would not be adversely impacted from smoke. • Hiding cover would be maintained near dependable waters by not targeting drainages for openings, and through implementation of watershed BMPs. • Tanks within ¼ mile of known northern leopard frog sites would be surveyed prior to implementation. If northern leopard frogs are detected, a buffer for no treatments (no thinning, no direct ignition) would be identified to protect occupied tanks. • Aquatic Management Zones (AMZs) would be established around designated streamcourses and would provide protection for northern leopard frogs by limiting the

Specialist Area	Related Resource	Design Feature
		type of disturbance which could occur within the AMZ. • Primary red squirrel caches would generally be protected at a density of one cache per two acres where current cache numbers allow.
	Snags	• Use logging systems when feasible in sensitive habitats that can meet project objectives and maintain important structural components (e.g., snags, etc.). • Protect snags and logs wherever possible through site prep, implementation planning, and ignition techniques to retain within the project area an average of approximately ≥ 2 snags per acre ≥18 inches dbh and ≥30 ft in height and ≥3 logs with ≥ 12 inches mid-point diameter and ≥ 8 ft in length in ponderosa pine and ≥ 3 snags per acre ≥18 inches dbh and ≥30 ft in height and ≥5 logs with ≥12 inches mid-point diameter and ≥ 8 ft in length in mixed conifer and spruce-fir • Within the project area, retain an average of approximately ≥ 2 trees per acre ≥18 inches dbh with dead tops, cavities, and lightning strikes wherever possible to provide for replacement snags and cavity nesting/foraging habitat • Emphasize retention of snags exhibiting loose bark to provide habitat for roosting bats. • Create snags in key areas (i.e. PACs, recovery nest roost habitat) where monitoring determines a deficit. Trees would be chosen on a case-by-case basis in order to ensure successful recruitment as snags. Created snags, or a subset of, would be monitored over time to determine if the action was successful (i.e. trees decayed but remained standing, etc.).
Wildlife (cont)	Caves, Karst and Sink Holes	Treatment buffers will be designated around cave entrances, sink hole rims, and drainages leading to these features to protect cave ecosystems (including microclimate, hydrology, and entrance vegetation) and reduce potential disturbance to roosting bats. No direct ignition of fire within buffer.
Botany	Noxious/Invasive Weeds	Best Management Practices as outlined in Appendix B of the "Final Environmental Impact

Specialist Area	Related Resource	Design Feature
		Statement for Integrated Treatment of Noxious or Invasive Weeds" (USDA Forest Service 2005) would be followed to incorporate weed prevention and control into the project. The following features would be incorporated into project implementation and monitoring: • Prevent the spread of potential and existing noxious or invasive weeds by vehicles used in management activities by incorporating weed prevention and control into project layout, design, and implementation. • Prior to ground-disturbing activities, survey for and prioritize and implement treatments of noxious or invasive weeds in project operating areas including landings , permanent and temporary roads and roads to be closed or decommissioned. • Avoid existing noxious or invasive weeds during soil disturbing activities when possible. • Clean all off road vehicles, machinery and tools of seeds, soil, vegetative matter, and other debris that could contain or hold seeds prior to entering the project area, when moving from one potentially-infested area to another area, and when leaving the project if the area the equipment was previously operating in has identified noxious weeds, or it is unknown if the area has weeds (eg private or other ownership, or areas we have not surveyed). • Fully incorporate the equipment cleaning provisions of the timber sale and/or stewardships contracts into the implementation contract(s) to prevent the introduction or spread of noxious or invasive weeds. • When in areas where known noxious weeds exist, designate turnaround sites for log trucks and other large equipment that are weed free. • Manage prescribed fires to promote native species, aid in control of existing weed infestations and prevent spread of existing weeds through coordination with the District Weeds Coordinator. • Place slash piles on previously used locations such as old piling sites, old log

Specialist Area	Related Resource	Design Feature
		deck sites, or other disturbed sites to avoid severe disturbance to additional locations where possible. • Monitor slash pile sites after burning and if found, control noxious or invasive weeds. • Avoid acquiring water for dust abatement from weed-infested areas. • Minimize period from end of project activities to site preparation, revegetation, and contract closure.
	Sensitive Plants	• Mitigate loss of individuals and groups of Rusby milkvetch during management activities by avoiding known population locations • Construct slash piles at least 10-20 feet away from known populations of Rusby milkvetch where possible. • Construct slash piles at least 10-20 feet away from known populations of Rusby milkvetch where possible. • Avoid constructing mechanical slash piles within known populations of Rusby milkvetch. • Minimize temporary road construction or reconstruction within known populations of Rusby milkvetch. • Minimize construction, reconstruction or log landings within known populations of Rusby milkvetch • Leave tree groups may include Rusby milkvetch populations where practical, using areas not occupied by the plants as openings. • Manage prescribed burns at low to moderate intensity to promote native species and to hinder weed species germination. • Monitor the effects of treatment on Region 3 sensitive plants after treatments are completed in areas with known populations.
Soil/Watershed	General	• In order to avoid negative impacts to soils and water resources, best management practices (BMPs) would be implemented for prescribed fire and mechanical vegetation treatment measures. These resource protection measures are derived mainly from the Soil and Watershed Conservation Practices Handbook (USDA, 1990) and the National Best Management Practices for

Specialist Area	**Related Resource**	**Design Feature**
		Water Quality Management on National Forest System Lands, Volume 1: National Core BMP Technical Guide (USDA, 2012). Resource protection measures are implemented to protect soils and minimize nonpoint source pollution as outlined in the intergovernmental agreement between the Arizona Department of Environmental Quality and the Southwest Region (Region 3) of the Forest Service (ADEQ, 2008). BMPs would be incorporated in prescribed fire burn plans and timber harvesting or stewardship contracts.
	Prescribed Fire	• Incorporate prescription elements into the prescribed fire plan including such factors as weather, slope, aspect, soils, fuel type and amount, and fuel moisture in order to minimize high soil burn severity. • Consider the spatial distribution and contiguous size of the planned burn area in a watershed during prescription development to reduce the effects of peak flow change on channels.
	Timber Harvesting	At a minimum, all perennial water bodies, wetlands, and areas with riparian ecosystems would be designated as Aquatic Management Zones (AMZs), also called filter strips in the 1987 Coconino National Forest Plan. Those stream channels that support seasonal flow in response to snowmelt and/or seasonal fluctuations in the water table would also be evaluated for potential designation as AMZs. AMZ widths would be adjusted based on the steepness of upgradient hillslopes with the following general guidelines: • AMZ width is the distance measured perpendicularly from the outer edges of the streamcourse (i.e., channel bank) or wetland. For stream courses or wetlands with upgradient hillslopes of 35 percent or less, the AMZ width would be 50’. For those with upgradient hillslopes greater than 35 percent, AMZ width would be 100’. As an example, the total width of an AMZ for a streamcourse with an upgradient hillslope exceeding 35 percent would be 200’ plus the width of the streamcourse.

Specialist Area	Related Resource	Design Feature
		Equipment/vehicle staging areas, and fuel used for ignition devices would be located outside of AMZs. Ignition of fuels would not be initiated within AMZs. Hand piling and burning of slash within AMZs would be avoided to the extent practicable.
		Containment lines would be sited and constructed in a manner that minimizes erosion and prevents runoff from directly entering water bodies by consideration of placement relative to the water body(ies) and lay-of-the-land and through construction and maintenance of suitable drainage features such as water bars. To the extent possible, wetlands and riparian areas would be avoided. Where applicable, natural fire breaks such as outcrops would be used in lieu of ground-disturbing containment lines. In general, spacing of water bars would be such that water bars are located at eye level when viewed starting at the bottom of a slope and traversing upward.
		Staging areas would be kept as small as possible while allowing for safe and efficient operation.
		Prior to conducting harvesting activities, all AMZs, staging areas (including areas where vehicles are serviced, equipment/chemicals are stored, and/or fuel is dispensed), primary skid trails, cable yarding corridors, temporary roads, and landings would be designated on a map and visibly marked by means of flagging or other suitable measures for approval by the timber sale administrator. Temporary fuel storage tanks would be permitted and installed in accordance with the Office of the State Fire Marshall requirements. If the total oil or oil products storage exceeds 1,320 gallons in containers of 55 gallons or greater, Purchaser shall prepare a Spill Prevention Control and Countermeasures Plan. Such plan shall meet applicable EPA requirements (40 CFR 112), including certification by a registered professional engineer.
		To the extent possible, skid trail design would not include long, straight downhill segments which would concentrate runoff. If it is not operational feasible to avoid a long straight downhill segment, skid trail rehabilitation

Specialist Area	Related Resource	Design Feature
		measures would be applied as soon as skidding is completed on that trail. Cable yarding corridors would be located to efficiently yard materials with the least soil damage. Skidding or cable yarding up or down drainage courses would not be permissible unless, in the case of cable yarding, logs are fully suspended.
		Insofar as safety permits, trees would be felled to angle in the direction of skidding.
		Drainage of roads would be controlled by a variety of methods including but not limited to insloping of the road bed toward an interior drainage ditch with periodic cross drains, outsloping of the road bed, crowning of the road bed, and construction of rolling dips and water lead-off ditches. Drainage from landings and skid trails would be controlled to prevent concentration of runoff.
		Equipment would not be operated when ground conditions are such that excessive damage would result as visually monitored through such indicators as soil rutting.
		Machine piling of logging slash would be done in such a manner as to minimize the construction of new clearings for slash piles through use of natural openings, temporary roads, and landings.
		Skid trails and cable yarding corridors would be restored after use by a combination of any or all of the following practices in order to prevent the concentration of runoff in skid trails and to protect exposed soil: reshaping the surface to promote dispersed drainage (i.e., create convex vs. concave cross-section), installation of drainage features such as water bars to shed water, and spreading slash across skid trails and cable yarding corridors to protect areas where mineral soil is exposed. Where skid trails and or cable yarding corridors intersect existing roads or trails, native materials such as logs, slash, and/or boulders would be placed along skid trail or cable corridor to line-of-sight or first 300’, whichever is greater.
		Temporary roads and landings would be restored after use by a combination of any or all of the following practices in order restore original topography, protect soils, and prevent

Specialist Area	Related Resource	Design Feature
		concentrated runoff: roll berms created during temporary road and/or landing construction back across the disturbed surface to restore original surface topography to the extent practicable, install drainage features such as water bars where needed to prevent runoff from concentrating, and spread slash on areas with exposed mineral soil. Where temporary roads intersect existing roads or trails, native materials such as logs, slash, and/or boulders would be placed along temporary road to line-of-sight or first 300', whichever is greater. Where visual observation indicates that the above methods of erosion protection are inadequate, a certified weed-free mix of native or naturalized grasses would be broadcast evenly over the inadequately protected surface at the rate of 5 pounds per acre after surface scarification.
Recreation	Public Awareness	• Inform forest visitors about activities within the project area and make them aware of potential impacts when visiting this part of the forest. Provide information about implementation activities on the Forest website. • Issue news release(s) as appropriate when forest restoration activities are scheduled to occur and how it may affect forest visitation. • If it is necessary to close forest roads during harvesting operations for public safety, notices and signs would be posted at key locations adjacent to and within the project area to inform the public of these closures, in conjunction with issuing news releases as stated above. This may include major FS roads accessing the area, kiosks at trailheads, bulletin boards, electronic sign boards, etc. • Utilize dust abatement methods during haul of logs on unpaved roads near private land residences during the season when dust is likely and funding is available
	Forest Service Trails	• Harvesting activities would avoid existing forest system trails[16], if possible. If it is

[16] Existing forest system trails are identified in Chapter 3 of the EIS.

Specialist Area	Related Resource	Design Feature
		determined necessary that an existing forest system trail must be used as a temporary road or skid trail, then the trail would be restored to USFS standards post-treatment. • It is acceptable to make perpendicular trail crossings. Trail crossing locations would be designated and flagged with input from the District Trails Coordinator or assigned personnel. Crossings of existing forest system trails would be restored to pre-project condition after use. • Forest restoration treatments within close proximity (i.e. 100’-200’) of existing forest system trails would consider “feathering” the treatment so the visual impacts are more transitional than abrupt and as to not significantly change the character or experience of the trail. • Existing forest system trails originally designated for “single track” use (motorized and non motorized) would be avoided for use as skid trails or temporary roads. • Public outreach efforts (e.g. additional signage, postings at trailhead kiosks, maps on the website) will occur prior to treatment to increase public understanding of what trails are within the forest system (and thus will be protected and/or restored) and which are not.
	Special-Use Events	Coordinated efforts would be made with sponsors of recreational special-use events (i.e. running or mountain biking races) to minimize the impacts on such events within the project area during implementation. Alternative locations would be identified to meet the needs of the special-use event if forest management activities conflict with preferred locations and cannot be resolved through timing.
	High-Use Weekends and Holidays	Efforts would be taken to limit forest treatment activities within the project area during high-use weekends and holidays (i.e. Memorial Day, 4th of July, Labor Day, etc.); especially in locations where recreation based activities (i.e. trails, trailheads, etc.) occur.
	Hunting Access	Temporary closures of forest roads and/or portions of the project area during implementation would be coordinated with AZGFD during hunting seasons to reduce

Specialist Area	**Related Resource**	**Design Feature**
		impacts on hunter and angler access.
	Mt. Elden Environmental Study Area	Measures would be taken to safeguard the trails and interpretive signs/markers within the Mt. Elden Environmental Study Area from forest restoration activities.
	Wilderness	Improve the wilderness boundary marking where forest restoration operations are planned within close proximity (i.e. ¼ mi.) of a wilderness area. Forest restoration treatments within close proximity (i.e. ¼ - ½ mile) to a wilderness area would consider "feathering" the treatment so the visual impacts are more transitional than abrupt.
Scenery	Edges of Individual Units	Thinning forest vegetation geometric shapes (such as linear corridors from cable yarding) would be avoided when it does not interfere with implementation feasibility or safety, and high contrast would be avoided between treatment locations. Use the following techniques: • Shape and/or feather the edges of treatment areas to avoid abrupt changes between treated and untreated areas. • Where the treatment unit is adjacent to denser forest (treated or untreated), the percent of thinning within the transition zone (150-250 feet) would be progressively reduced toward the denser edges of the unit. • Similarly, where the treatment unit interfaces with an opening (including savannah and grassland treatments, and natural openings) the transition zone would progressively increase toward the open edges of the unit. • Soften edges by thinning adjacent to the existing unit boundaries. Treat up to the edges; do not leave a screen of trees. Favor groups of trees complying with the prescribed treatment that visually connect with the unit's edge to avoid an abrupt and noticeable change. • Treatment boundaries should extend up and over ridgelines to avoid the "Mohawk" look. • Avoid widely spaced individual trees that are silhouetted along the skylines.
	Unit Marking	• Avoid using trails as boundaries especially for different prescribed treatments.

Specialist Area	Related Resource	Design Feature
		• Avoid abrupt changes between treatment units. Use the techniques suggested for edges of treatment units (above). • Where possible, mark trees on the side facing away from roads, trails and developed recreation sites.
	Road, Skid Trail & Landing Construction	• Utilize dust abatement methods during haul of logs during the season when dust is likely and funding is available. Priorities would include residential areas, private land and adjacent to recreation sites. Coordinate with Coconino County on the application and timing of application of dust abatement on road segments that have County Maintenance responsibilities. • Utilize existing skid roads and landings to the extent possible. • Log landings, temporary roads, and skid trails should be minimized within sensitive viewsheds such as those next to developed recreation sites, private homes or communities, paved and passenger car level roads and trails. • To hasten recovery and help eliminate unauthorized motorized and non-motorized use of skid trails and temporary roads, use physical measures such as re-contouring, pulling slash and rocks across the line, placing cull logs perpendicular to the route, and disguising entrances. • If areas where piles were burned are not naturally restored, it may be necessary to scratch in seed and soil from unburned areas in order to assure vegetative cover
	Cull Logs, Stump Heights & Slash Treatments	• Cull logs would not be abandoned on landings. • Use cull logs for closing temporary roads and decommissioning roads, and for closed, undesignated roads if appropriate. • Cull logs may also be suitable to use as down woody material, but must be scattered away from the landings. • Stump heights should be cut as low as possible. • Unless used for erosion control or maintenance of soil productivity, slash on log landings must be treated or removed. • In the seen area immediate foreground of

Specialist Area	Related Resource	Design Feature
		sensitive places (within 300 feet of the centerline of paved or passenger car level roads or trails, or 300 feet from the boundary of a recreation site or private land/communities): o Where whole tree logging occurs, machine piling may occur to the middle/back of log landings. Prioritize slash burning in these locations within one year or as soon as possible after treatment. • Root wads and other debris in sensitive foreground areas would be removed, buried, burned, or chipped. If materials are buried, locate in previously disturbed areas where possible, such as areas for road obliteration. Beyond sensitive immediate foreground areas, it is acceptable to scatter these or use them to help decommission temporary roads or skid trails. • Place project-generated slash outside of permitted utility line and pipeline rights-of-way; do not interfere with utility corridor management.
	Fire Control Lines	• Wherever possible, construct fire lines to reduce the contrast so that they are not noticeable in the middle and background views. • Generally restore control lines to a near undisturbed condition in the foregrounds (within 300 feet) of roads, trails, and developed recreation sites with high scenic integrity objectives. • To hasten recovery and help eliminate unauthorized motorized and non-motorized use of control lines, use measures such as re-contouring, pulling slash and rocks across the line, and disguising entrances to non-system roads and trails.
Range	Infrastructure	• Protect range infrastructure from prescribed fire (e.g. by lining fence stays). • Upon completion of implementation, cattle guards would be cleaned to pre-implementation condition.
	Implementation	• Coordinate implementation activities with range specialists when implementation would impact an active grazing allotment. • Vehicles passing through grazing pastures

Specialist Area	Related Resource	Design Feature
		would close gates upon entering and exiting the area to ensure livestock remain in the correct pasture.

Federal agencies are required by NEPA to rigorously explore and objectively evaluate all reasonable alternatives and to briefly discuss the reasons for eliminating any alternatives that were not developed in detail (40 CFR 1502.14). Public comments received in response to the Proposed Action provided suggestions for alternative methods for achieving the purpose and need. These alternatives were outside the scope of reducing the potential for high-severity wildfire. Therefore the two alternatives discussed below were considered, but dismissed from detailed consideration for reasons summarized below.

Alternatives Considered but Dismissed from Further Analysis

The following two alternatives identified through scoping comments were discussed by the IDT and determined to not meet the purpose and need for the project.

Alternative 5: No Temporary Road Use or Forest Plan Amendments & Hand Thinning Only

This alternative would involve hand thinning only with no amendments to the Forest Plan, and would utilize existing, open roads only. No new temporary roads would be constructed and no existing, closed roads would be utilized. Under this alternative achieving the desired conditions of reduced high-severity wildfire and achieving a sustainable forest structure would not be possible due to: the preponderance of trees greater than 9 inches dbh, (the standard limit for hand thinning treatments), the safety concerns of hand felling larger trees on steep rocky slopes, the inability to remove cut material which would leave an overabundance of fuels on the ground, and the subsequent need for extensive hand piling and burning on steep slopes.

Alternative 6: Kachina Peaks Wilderness

This alternative would include expanding the DLH portion of the project area to include treating in the Kachina Peaks Wilderness. While portion of the wilderness could potentially benefit from treatments that reduce the potential for uncharacteristically large, high-severity wildfire, the inaccessibility, high fuel loadings, and rough terrain of the area would require road development and treatment of an extent that would clearly be in conflict with the objectives of a designated Wilderness area. Namely, that of maintaining wilderness in such a manner that “ecosystems are unaffected by human manipulation and influences so that plants and animals develop and respond to natural forces” (FSM 2320.2(2)).

Comparison of Alternatives

This section provides a summary of the differences between the alternatives and their effects. The tables below contain information that is focused on activities and effects where different levels of effects or outputs can be distinguished quantitatively or qualitatively among alternatives.

Table 25: Comparison of Proposed Actions between Alternatives

Actions	Alternative 1 – No Treatment	Alternative 2 – Proposed Action with Cable Logging	Alternative 3 – Proposed Action without Cable Logging	Alternative 4 – Minimal Treatment
Total Treatment Acres	Jack Smith Schultz/Eastside[17]	8,937 acres *5,963 acres DLH* *2,975 acres MM*	8,937 acres *5,963 acres DLH* *2,975 acres MM*	5,802 acres *3,459 acres DLH* *2,343 acres MM*
Percentage of Total Project Area to be Treated	0%	85% *79% DLH* *100% MM*	85% *79% DLH* *100% MM*	55% *46% DLH* *79% MM*
Acres to be Hand Thinned	0 acres	846 acres *699 acres DLH* *147 acres MM*	832 acres *652 acres DLH* *180 acres MM*	438 acres *438 acres DLH* *0 acres MM*
Acres to be Mechanically Thinned	0 acres	7,124 acres *4,697 acres DLH*[18] *2,427 acres MM*	7,137 acres *4,743 acres DLH* *2,394 acres MM*	5,264 acres *2,953 acres DLH* *2,311 acres MM*
Acres to be Helicopter Logged	0 acres	0 acres	973 acres *973 acres DLH* *0 acres MM*	0 acres
Acres to be Cable Logged	0 acres	1,291 acres *1,185 acres DLH* *106 acres MM*	0 acres	0 acres

[17] Past projects with acreages within the FWPP boundary that could be implemented

[18] Includes cable logging areas that could be cut by hand

Actions	Alternative 1 – No Treatment	Alternative 2 – Proposed Action with Cable Logging	Alternative 3 – Proposed Action without Cable Logging	Alternative 4 – Minimal Treatment
Acres to be treated by Specialized Steep Slope Equipment	0 acres	0 acres	346 acres *273 acres DLH* *73 acres MM*	0 acres
Acres to be Prescribed Burned	0 acres	8,937 acres *5,963 acres DLH* *2,975 acres MM*	8,937 acres *5,963 acres DLH* *2,975 acres MM*	5,802 acres *3,459 acres DLH* *2,343 acres MM*
Campfire Closure Order	No	Yes	Yes	Yes
Forest Plan Amendments	No	Yes 1. Related to MSO 2. Mechanical Treatment on slopes >40%	Yes 1. Related to MSO 2. Mechanical Treatment on slopes >40%	Yes 1. Related to MSO 2. Mechanical Treatment on slopes >40%
Harvest Methods for treatments on slopes ≥ 40%	N/A	Combination of hand thinning, mechanized equipment, and cable logging	Combination of hand thinning, mechanized equipment, and helicopter logging	No treatment except for select areas of hand thinning
Acres Treated in MSO Protected Habitat	0 acres	3,926 acres (99%)	3,954 acres (100%)	2,427 acres (61%)
Acres Treated in MSO Recovery Habitat	0 acres	2,584 acres (86%)	2,584 (86%)	927 acres (31%)
Treatments in MSO Nest Cores	No	Yes, hand thinning 122 acres and prescribed burning all (785 acres total)	Yes, hand thinning 122 acres and prescribed burning all (785 acres total)	Yes, hand thinning and prescribed burning of 122 acres total.
Acres Treated by Cable Logging within MSO PACs[19]	0	465 acres	0 acres	0 acres
Cable Corridor Acres within MSO PACs	0	74 acres	0 acres	0 acres

[19] Indicates acres where all snags would have to be removed for safety purposes.

Actions	Alternative 1 – No Treatment	Alternative 2 – Proposed Action with Cable Logging	Alternative 3 – Proposed Action without Cable Logging	Alternative 4 – Minimal Treatment
Acres Treated by Helicopter Logging within MSO PACs[20]	0	0 acres	267 acres	0 acres
Total Temp Roads Mileage	0 miles	21.20 miles *17.61 DLH* *3.59 MM*	15.39 miles *12.87 DLH* *2.52 MM*	12.92 miles *10.40 DLH* *2.52 MM*
Temp Road Mileage within MSO PACs	0 miles	4.7 miles	3.1 miles	3.1 miles
System Road Decommissioning	0 miles	4.38 Miles	4.38 Miles	4.38 Miles

Table 26 and Table 27 show a comparative summary the transportation system for all action alternatives

Table 26: Comparison of transportation systems proposed for each alternative, Dry Lake Hills

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
System haul roads within the project area	18.07 miles	18.07 miles	18.07miles	13.04 miles
System haul roads outside the project area	14.33 miles	14.33 miles	14.33 miles	7.37 miles
New temporary haul roads constructed	0.0 miles	14.86 miles	10.13 miles	9.42 miles
Temporary roads on existing road prisms	0.0 miles	2.75 miles	2.75 miles	0.99 miles

[20] Indicates acres where all snags would have to be removed for safety purposes

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Temporary road rehabilitated	0.0 miles	17.61 miles	12.87 miles	10.40 miles
Relocated system road used as haul road	0.0 miles	1.57 miles	1.57 miles	1.57 miles
System road decommissioned	0.0 miles	4.19 miles	4.19 miles	4.19 miles

Table 27: Comparison of transportation systems proposed for each alternative, Mormon Mountain

	Alternative 1	Alternative 2	Alternative 3	Alternative 4
System haul roads within the project area	16.46 miles	16.46 miles	16.46 miles	16.46 miles
System haul roads outside the project area	18.13 miles	18.13 miles	18.13 miles	18.13 miles
New temporary haul roads constructed	0.0 miles	1.07 miles	0 miles	0 miles
Temporary roads on existing road prisms	0.0 miles	2.52 miles	2.52 miles	2.52 miles
Temporary road rehabilitated	0.0 miles	3.59 miles	2.52 miles	2.52 miles
Relocated system road used as haul road	0.0 miles	0.53 miles	0.53 miles	0.53 miles
System road decommissioned	0.0 miles	0.19 miles	0.19 miles	0.19 miles

Table 28: Comparison of Effects between Alternatives

Actions	Alternative 1 – No Treatment	Alternative 2 – Proposed Action with Cable Logging	Alternative 3 – Proposed Action without Cable Logging	Alternative 4 – Minimal Treatment
Percentage of Project Area predicted to have active crown fire post-treatment	57% Total *51% DLH* *70% MM*	7% Total *9% DLH* *2% MM*	7% Total *9% DLH* *2% MM*	28% Total *32% DLH* *19% MM*
Percentage of MSO PAC acreage predicted to have active crown fire post-treatment	65% of PACs *65% DLH* *66% MM*	9% of PACs *17% DLH* *1% MM*	9% of PACs *17% DLH* *1% MM*	31% of PACs *37% DLH* *25% MM*
Percentage of project area predicted to have high soil burn severity in simulated wildfire post-treatment	39% DLH 62% MM	8% DLH 1% MM	8% DLH 1% MM	30% DLH 17% MM
Anticipated discharge (cfs) within DLH after a simulated wildfire, during Schultz Rain Event[21]	2,014 cfs	804 cfs	804 cfs	1,409 cfs
Total sediment delivery (tons) after simulated wildfire[22]	14,912 tons DLH 2,445 tons MM	8,277 tons DLH 1,432 tons MM	8,277 tons DLH 1,432 MM	12,977 tons DLH 1,551 MM

[21] Schultz rain event equates to the rain event on July 20, 2010, which produced approximately 1.78 inches in 45 minutes over the area impacted by the Schultz fire.

[22] In first year after simulated wildfire

Actions	Alternative 1 – No Treatment	Alternative 2 – Proposed Action with Cable Logging	Alternative 3 – Proposed Action without Cable Logging	Alternative 4 – Minimal Treatment
Projected length of treatment effectiveness[23]	n/a	The silviculture analysis documents that after 40 years, the majority of the areas that would be mechanically treated or hand thinned would have Basal Areas, Canopy covers, and trees per acres that are lower than the current conditions. In area of burn only treatment effectiveness last between 20 and 40 years before Basal Areas and Canopy Cover return to or exceed pre-treatment conditions.	The silviculture analysis documents that after 40 years, the majority of the areas that would be mechanically treated or hand thinned would have Basal Areas, Canopy covers, and trees per acres that are lower than the current conditions. In area of burn only treatment effectiveness last between 20 and 40 years before Basal Areas and Canopy Cover return to or exceed pre-treatment conditions.	The silviculture analysis documents that after 40 years, the majority of the areas that would be mechanically treated or hand thinned would have Basal Areas, Canopy covers, and trees per acres that are lower than the current conditions. In area of burn only treatment effectiveness last between 20 and 40 years before Basal Areas and Canopy Cover return to or exceed pre-treatment conditions.
Total number of trees >18” dbh within cable logging corridors to be removed in MSO PACs	0	132 Total *108 DLH* *24 MM*	0	0
Number of Trees >24” dbh within cable logging corridors to be removed in MSO Recovery Habitat	0	206 Total *206 DLH* *0 MM*	0	0

[23] Refers to the duration of time before additional mechanical thinning would be needed to restore post-treatment conditions. This does not include maintenance burning, which is anticipated to extend the effectiveness of treatments.

Actions	Alternative 1 – No Treatment	Alternative 2 – Proposed Action with Cable Logging	Alternative 3 – Proposed Action without Cable Logging	Alternative 4 – Minimal Treatment
Acres of treatment where all snags have to be removed for safety within MSO PACs	0	391 acres	267 acres	0 acres
Temp Road Mileage within MSO PACs	0 miles	4.7 miles	3.1 miles	3.1 miles
Road Decommissioning	0 miles	4.38 Miles	4.38 Miles	4.38 Miles
Overall effects to MSO	No Impact	May have impacts to breeding owls as treatments could occur within PACs during the breeding season for up to two years; cable corridors would affect quality of critical habitat in the short-term through the removal of snags and large trees. Long-term benefits would include reduction in the potential for high-severity wildfire.	May have impacts to breeding owls as treatments could occur within PACs during the breeding season for up to two years; areas treated by helicopter would affect quality of critical habitat in the short-term through the removal of snags. Long-term benefits would include reduction in potential for high-severity wildfire.	May have impacts to breeding owls as treatments could occur within PACs during the breeding season for up to two years. The project activities may affect, but are not likely to adversely affect MSO critical habitat due to the lack of having to remove large numbers of snags for safety requirements.
Total Implementation Cost (Net Timber Value minus Cost of Implementation)	$102,000 (cost of archaeological surveys completed)	$7,323,094	$8,512,238	$4,082,599

Discussion of Effects

Alternatives 2 and 3 would have the greatest reduction in active crown fire potential: from approximately 57 percent of the project area under the No Action Alternative to 7 percent under Alternatives 2 and 3, compared to approximately 28 percent under Alternative 4. Alternatives 2 and 3 would also result in the greatest reduction in post-fire predicted peak discharge associated with a 100-year storm event (1 percent recurrence interval): 60 percent reduction for Alternatives 2 and 3 versus 30 percent reduction for Alternative 4 as compared to the No Action Alternative.

Due to the cable logging corridors and the safety requirements of both cable logging and helicopter logging, Alternatives 2 and 3 would remove the greatest number of snags, resulting in greater impacts to Mexican spotted owl (MSO) critical habitat. Per the MSO-related Forest Plan amendment, all three action alternatives would include thinning and prescribed burning in the Schultz Creek nest core, prescribed burning only in the other nest cores, mechanized thinning up to 18 inches dbh in PACs, and treatments within PACs would be allowed for up to two breeding seasons, which would result in impacts to MSO. Project activities are not anticipated to change trends for any Management Indicator Species (MIS), or Forest Service Sensitive Species. The Wildlife section of Chapter 3 contains more detailed analysis of the impacts on wildlife.

Under all three action alternatives, old growth and large trees in both ponderosa pine and mixed conifer vegetation types would be retained per the incorporated design features. At a project level, there is little difference between action alternatives in the number of trees greater than 18 inches dbh post-treatment, with trees greater than 24 inches dbh likely to be removed only under Alternative 2 for cable logging corridors. On Mormon Mountain, there is no difference shown in modeling as the wet mixed conifer band that is deferred in Alternative 4 would still receive only light treatment in the other two action alternatives (creating regeneration pockets within aspen stands, piling and burning of dead and down material). In the Dry Lake Hills, there is a slight difference in the ponderosa pine treatments, where an average of four trees per acre greater than 18 inches dbh would be cut in Alternatives 2 and 3, and an average of three trees per acres greater than 18 inches dbh would be cut under Alternative 4. Trees greater than 24 inches dbh would not be targeted for removal under any alternative, and in fact, the only place that the modeling shows them being removed is in the cable corridors under Alternative 2.

The length of treatment effectiveness is not affected by the harvesting method; rather, the relevant factor is the intensity of the proposed treatment (e.g. how many trees would be removed and the desired forest structure). For all alternatives, the ponderosa pine restoration treatments are the most effective treatments over 40 years, followed by the MSO Recovery Habitat treatments, and then the MSO PAC treatments. Hand thinning treatments also show having effects lasting 40 years as they were strategically proposed for locations where they would provide the most benefit. The burn only treatments appear to last between 20 and 40 years. This projections are based on the single entry treatment and do not factor in maintenance burning, which would be anticipated to extend the duration of effectiveness. These projections also only pertain to the areas of treatment themselves; as Alternative 4 would treat fewer acres than Alternatives 2 and 3, this could decrease treatment effectiveness at a landscape scale.

Chapter 3. Affected Environment and Environmental Consequences

This chapter summarizes the physical, biological, social, and economic environments of the project area and the effects of implementing each alternative on that environment. This also includes an analysis of the proposed Forest Plan amendments, which is included near the end of each resource section. It also presents the scientific and analytical basis for the comparison of alternatives presented in the alternatives chapter. Summaries for each resource area are provided and all specialist reports are incorporated by reference. Full specialist reports can be found in the project record, located at the Flagstaff Ranger District Office.

Fire & Fuels

This section discusses the effects and concerns of four alternatives on the fire hazard and fuels conditions within the project area. Specifically, this section addresses effects relating to fire hazard, vegetative condition, and fuel loading conditions of stands within the project area under the No Action Alternative as well as the action alternatives, and the projected condition of the project area in the next 20 years under each treatment option.

Several variables affect fire behavior on a site and over a landscape. Besides weather and terrain, (e.g. slope steepness, aspect, and landform types such as chutes, canyons, chimneys, saddles, etc.), the variables that play the largest role in influencing fire behavior within a forest include dead and live fuel loadings, fuel moistures, crown bulk density (the volume of fuel available in tree crowns), crown base height (the height at which tree branches can be ignited by ground fire), and canopy closure (percentage of ground area vertically shaded by overhead foliage) (Agee and Skinner 2005).

These variables, depending on their structure and arrangement, can create many different fire behavior outcomes for a landscape. Intense fire behavior will most likely occur during hot, dry, and windy weather conditions under forest conditions of high fuel loadings, including a large number of trees per acre, high crown bulk densities, low crown base heights, and large percentages of canopy closures.

Fire hazard ratings are used to quantify the intensity with which a fire can burn over a landscape during hot, dry and windy conditions. These weather conditions typically occur from April through July on the Mogollon Rim (where FWPP is located), until a monsoonal weather pattern sets up. Fire hazard ratings assigned to an area reflect the collective effects of fuel loadings, crown bulk density, crown base height and canopy closure on fire behavior if a wildfire were to occur in the same area under 97th percentile weather conditions. This analysis uses both 97th percentile weather and 2010 Shultz Fire weather conditions to give both a worst case scenario and a scenario that has already occurred in the watershed around Flagstaff. For the analysis, the 97th percentile weather conditions will only be used to show existing condition; whereas, 2010 Schultz Fire weather conditions will be used for both existing conditions and alternative comparison (see Methodology section for more information).

Fire Hazard Ratings range from *extreme* to *low,* with *extreme* indicating that the area rated as such is in the highest danger of a worst case wildfire scenario. That is, the area rated as *extreme* will most likely experience high intensity fire if a wildfire were to start during hot, dry, and windy conditions. This type of fire would most likely be stand replacing and would create and/or result in fire effects outside the historical range of variability for ponderosa pine and mixed conifer ecosystems in the project area.

This section also uses Fire Regime Condition Class (FRCC) as a metric in determining the existing ecosystem health of a landscape as it relates to historic condition. This metric in its original form reflects the current vegetative structure, composition, and amount in relation to the departure of that structure, composition, and quantity from the natural range of variability for that area.

Methodology & Assumptions Used in Analysis

A fire regime generally classifies the role of fire over the landscape in the absence of modern human mechanical intervention. There are five natural fire regimes, which are characterized based on average numbers of years between fires combined with fire severity of the dominant overstory vegetation. One can examine fire regimes at a finer scale in which each regime can be described at three different condition classes (I, II, III), also known as fire regime condition classes (FRCCs). Condition classes were created to characterize the importance of fire frequency in ecosystems. FRCC quantifies the amount that current vegetation has departed from the simulated historical vegetation reference conditions due to an absence of fire and an increase in fire return intervals (Havelina et al. 2010).

The deviation from the historic fire regime is measured according to the number of fire return intervals missed and the disturbance regime altered so as to alter current structure and composition of the system outside the normal range of variation (LANDFIRE 1.1.0). FRCC includes measures of the departure from historic fire severity and frequency for a given landscape. The level of departure is attributable primarily to an increase in fire suppression and fire exclusion over the last 125 years and/or an increase in fire return intervals within the area (e.g. fires occur less frequently), thereby altering the ecological function of fire within that area. The lack of low intensity, high frequency fires in the forests of northern Arizona have led to forest conditions of higher fuel loadings and a larger number of small and medium-sized trees per acre compared to the conditions that occurred historically.

FRCC is a difficult metric to develop accurately using tools currently available. For this analysis, fire regimes and FRCCs within the project were assessed using LANDFIRE (LANDFIRE 2013). LANDFIRE uses vegetation condition class (VCC) as a surrogate to FRCC, but lack values in fire regime departure (Hann and Bunnell 2001). The fire regimes for the project area include I, III, IV, and V and the condition classes range from level 1 to level 3. In general, if fire is absent for more than 100 years, most likely the fire will result in some stand replacement with the rest resulting in surface fire activity. Fire regime I indicates that historical fires reoccur in less than a 35 year period, with fires resulting in a low percentage of overstory trees in the stand being replaced. Fires in a stand of fire regime III would generally reoccur every 35 to 200 years with mixed/low severity. Fire Regime IV indicates 35 to 100 year frequency, high replacement severity. Fire regime V indicates greater than 100 year frequency and severity.

The fuel moisture and weather characteristics used to model the effects and behavior of a potential wildfire for existing and desired conditions are conditions under 97th percentile and conditions observed on the Schultz fire on June 20th, 2010. The conditions used were as follows:

97th Percentile Conditions

- 1-hour fuel moisture: 2%
- 10-hour fuel moisture: 2%
- 100- hour fuel moisture: 4%
- 1000- hour fuel moisture: 7%
- 20-foot wind speed: 35 mph
- Air temperature: 85^0F

These weather conditions were used in modeling to give an overall worst case scenario in terms of crown fire potential. The 97th percentile conditions represent the top 3 percent worst fire weather days from 2002-2013.

Schultz Fire Conditions

- 1-hour fuel moisture: 3%
- 10-hour fuel moisture: 3%
- 100- hour fuel moisture: 6%
- 1000- hour fuel moisture: 11%
- 20-foot wind speed: 23 mph
- Air temperature: 74^0F

These weather conditions were used in modeling because the Schultz Fire was one of the biggest high intensity/stand replacing fires that has occurred most recently within fifteen miles of Flagstaff, Arizona and the fire resulted in a considerable amount of immediate damage and devastation to ecological resources and values at risk within the fire and to surrounding areas.

Weather conditions used in FVS/FFE for prescribed fire under all action alternatives are as followed. Weather conditions used are common for prescribed fire activity on the Flagstaff RD. However variables such as wind speed, air temperature, and moisture contents are on the upper end of prescriptions. Typically prescribed fire would be implemented under more moderate conditions; this report analyzes higher end limits of prescribed fire conditions in order to be as conservative as possible to address concerns about potential impacts of prescribed fire.

- 1-hour fuel moisture: 8%
- 10-hour fuel moisture:8%
- 100- hour fuel moisture: 10%
- 1000- hour fuel moisture: 15%
- 20-foot wind speed: 10 mph
- Air temperature: 80^0F
- Live fuel moisture: 110%
- Duff moisture content 50%

The objective of the modeling performed in this analysis is to:

1. Clarify potential effects of a wildfire burning under conditions similar to the Schultz fire and 97th percentile weather conditions.
2. Identify areas where fire behavior may be problematic from the perspectives of both fire effects and control issues.
3. Analyze and evaluate the effects of the different alternatives.

The following metrics will be used to evaluate fire behavior and effects, and are grouped into three main sections for the analysis: ground fuels and vegetation; fire suppression, and wildfire hazard. For more details on model inputs, methodology and assumptions, refer to the Fire & Fuels Specialist Report located in the project record.

1) Fire Behavior (active/passive crown fire, surface fire, heat/unit/area, and fireline intensity)
2) Arrival time: There is no way to know with any certainty where a wildfire would start, so three separate ignition point sources were used. Areas used in modeling were identified by the District Fuels Specialist based on values at risk, such as urban interface concerns, watershed values and recreational activities that occur in the project areas. Modeling parameters included Schultz fire weather conditions. Ignition source locations used in the DLH area for modeling were:
   a) The intersection of Forest road (FR) 420 and 557 (the Y)
   b) The intersection of FR 557 and Lower Oldham Trail.
   c) At the National Forest boundary north of Paradise Street.

The modeling ignition location on MM was placed on along FR 648 (Mormon Mountain Tower Road). The three areas in the DLH and the one location on MM are identified on the Arrival time maps for each alternative below.

3) Emissions: Particulate matter of 2.5 microns or less (PM 2.5) is addressed in the Clean Air Act and has a NAAQS annual mean of 15µg/m3, and a 24 hour average of 35µg/m3. Although modeling total potential outputs, it is important to note that it is not the total amount of emissions from a fire that affect human health, but rather how concentrated pollutants in ambient air are for a period of time. PM 2.5 emission amount under a wildfire scenario are estimated using FVS per alternative

4) Fire Hazard Ratings: Fire hazard ratings were calculated for existing and desired conditions for 50 percent of the DLH and 93 percent in the MM project areas, commensurate with the area in which field data was collected in each portion of the total project area. Less data was collected in the DLH due to steep slopes and lack of access. The field data collected to calculate existing fire hazard ratings in the project area include dead and down fuel loading (tons per acre), number of tree stems per acre, tree diameter, percent canopy closure, height to bottom of live crown (crown base height), and tree height. Slope and aspect also affect fire hazard ratings and therefore were acquired for stands in the project area using 10 Meter Digital Elevation Models.

5) Crown fire potential (pre and post treatment): assessed using FlamMap 5.0 modeling, including LANDFIRE data GIS. The data layer is a representation of the type of fire that would be burning at any given location in the project area within two scenarios: 1) Weather conditions at the 97th percentile to represent the “worst case” scenario, prevailing winds being out of the southwest, and sustained winds at 35mph, and 2) Schultz Fire 2010 weather conditions to represent an existing scenario, prevailing winds being out of the southwest at 23mph. Actual number of acres analyzed may differ from the proposed action acreage due to modeling outputs and pixel calculations.
   a) Three types of fires result from the modeling: Surface fire describes fire that burns through the surface fuels of the forest floor. This type of fire has the least active of fire behaviors and is the most beneficial of the three types of fires in maintaining the historical, ecological role of low intensity, high frequency fire in the southwestern ponderosa pine ecosystem. Passive crown fire, or torching, occurs when flame lengths are long enough to reach the lower edge of the canopy and can result in individual or small group tree torching but does not proliferate through the forest canopy through continuous crown fire spread. Active crown fire occurs when flames reach the forest canopy and spreads through it with intensity and continuity.

Flame Length, Stand Conditions (trees per acre, crown base height, crown bulk density, and down woody debris), and Predicted PM 2.5 smoke emission under a wildfire scenario were calculated using the Fire and Fuels Extension within the Rocky Mountain variant of the Forest Vegetation Simulator (FVS) for silviculture stand data for both existing and post treatment conditions. FVS was used to model proposed treatments and determine the effects of these treatments (thinning treatments only) on the fuel characteristics of and potential fire behavior under severe fire conditions within proposed treatment areas within the project areas. Dead and down woody material data was collected in the field by both a contractor crew and the Flagstaff Ranger District fuels/silviculture crew, and modeled based on treatments identified in each alternative. Stand exam data including dead and down woody debris data was collected using FSVeg protocols in approximately fifty percent of the DLH area and ninety three percent in the MMM area. No surveying and stand exam data collection occurred in the remaining fifty percent of the DLH and seven percent in the MM project area. Severe fire conditions modeled in FVS utilizing 97th percentile weather conditions, and fire conditions modeled under 2010 Schultz Fire weather conditions. Exact weather parameters are listed under the Existing Conditions portion of this report. Flame Lengths were modeled for both a post treatments wildfire scenario (surface + crown fuels) and flame lengths during prescribed fire (surface fuels). Canopy cover was calculated differently than the base FVS model. To better account for local conditions that affect canopy cover, a formula derived from research completed in the area was used:

(-57.44+25.5047*LN(BA)).

This formula incorporates basal area (BA) calculated from FVS as a basis in the linear function for this formula. This formula also mirrors the formula used for the timber specialist report.

6) Fire regimes and condition classes: Table 29 and Table 30 describe the different fire regimes and condition classes.

Table 29: Historic Fire Regime Groups and Descriptions

Fire Regime	Frequency	Severity	Severity Description	Vegetation types that would be affected by treatments proposed under the FWPP
I	0 – 35 years	Low/ mixed	Mostly low severity replaces less than 25% of dominant overstory vegetation. May include mixed-severity fires that replace up to 75%	In pure ponderosa pine, pine/oak, and savanna ponderosa pine is the dominant species, so the severity of a burn is related to the fire effects on the pine.
II	0 – 35 years	Replacement	High severity replaces greater than 75 % of dominant overstory (grasslands).	Grasslands and some dry mixed conifer vegetation types fall into this category. The herbaceous layer (grasses and forbs) are the dominant species. Greater than 75 percent of these are generally topkilled by a fire, so it is considered high severity.
III	35 - 100 years	Mixed/ low	Generally mixed-severity; may also include low severity fires.	Some dry mixed conifer falls into this category.
IV	35 - 100 years	Replacement	High severity.	Wet Mixed Conifer and Aspen often falls into this category.

Fire Regime	Frequency	Severity	Severity Description	Vegetation types that would be affected by treatments proposed under the FWPP
V	100+ years	Replacement /any severity	Any severity may be included, but mostly replacement severity; may include any severity with this frequency	Much of the Piñon/Juniper (PJ) falls into this category, though there are different types of PJ systems and the fire return intervals vary.

Table 30: Condition Class definitions used for FRCC.

	Departure from historic Fire Regime
Condition Class 1	Fire regimes are within historical ranges. Risk of losing key ecosystem components is low. Vegetation attributes are intact and functioning within historical ranges.
Condition Class 2	Fire regimes moderately altered from historical range. Risk of losing key ecosystem components is moderate. Fire frequencies have departed from historical ranges by one or more return intervals. This has resulted in moderate changes to one or more of the following: fire size, intensity, severity, and/or landscape patterns. Vegetation attributes have been moderately altered from their historical range.
Condition Class 3	Fire regimes significantly altered from historical ranges. Risk of losing key ecosystem components is high. Fire frequencies have departed from historical frequencies by multiple return intervals resulting in dramatic alterations to: fire size, intensity, severity, and landscape patterns, and/or vegetation attributes.

Affected Environment

The following vegetation types occur in the DLH area include ponderosa pine, dry mixed conifer, aspen and grasslands; vegetation types in the MM project area include ponderosa pine, dry mixed conifer and wet mixed conifer. Fire behavior fuel model descriptions are outlined and described in Scott and Burgan (2005). The number and acres of fuel models located within the project area differ from the number and acres of fuel models for existing conditions due to available stand exam data; in other words, we only used stands for which we had data.

<u>Dry Lake Hills</u>

- Ponderosa pine- 4,059 acres
- Mixed conifer- 3,118 acres
- Pine /Oak woodland- 277 acres
- Aspen- 22 acres
- Grassland- 60 acres
- Right of way – 33 acres

<u>Mormon Mountain</u>

- Ponderosa pine- 1,924 acres
- Mixed conifer- 838 acres
- Wet mixed conifer – 213 acres

The fire hazard ratings and the corresponding acreages for the percentage of land surveyed in the DLH and MM project areas as analyzed are as follows:

Based on the 3,837 acres (50%) surveyed the fire hazard ratings and the corresponding acreages for the Dry Lake Hills project area are as follows:

Extreme- 2,582 acres (67 %)
Very High- 72 acres (2 %)
High- 613 acres (16 %)
Moderate-470 acres (12 %)
Low- 100 acres (3 %)

Based on the 2,784 acres (93%) surveyed the fire hazard ratings and the corresponding acreages for the Mormon Mountain project area are as follows:

Extreme- 2,089 acres (75%)
Very High- 197 acres (7%)
High- 273 acres (1%)
Moderate-174 acres (6%)
Low- 51 acres (2%)

The numbers above are a conservative estimate based on the areas that received stand exams. Because of the lack of fire within both project areas and knowledge of adjacent stand conditions, it is likely that the remaining unsurveyed acres would also be in the *high* to *extreme* rating. *Extreme* fire hazard ratings in the project areas were contributed to high fuel loading, low crown base heights, a large number of trees per acre, and/or large percentages for canopy closure. The percentages listed above are relative to the respective portions of the project area (e.g. for surveyed acres within DLH and MM) not for the project area as a whole.

All five fire regimes and all three VCCs are represented in the project area. Table 31 displays the acres for each Fire Regime and condition class (VCC) found in the DLH area. Table 32 displays the acres for each Fire Regime and condition class found in the MM area.

Table 31: DLH Summary Fire Regime and Condition Class Acres

Fire Regime I: Frequent Fires (0-35 years), surface to mixed burn severity		
Condition Class 1- low vegetation departure	Condition Class Level 2- moderate vegetation departure	Condition Class Level 3- high vegetation departure
6 ac. <1%%	644 ac. 12%	4,783 ac. 88%
Fire Regime III: 35 to 200 year frequency, low to mixed burn severity		
Condition Class Level 1	Condition Class Level 2	Condition Class Level 3
<1 ac. 0%	325 ac. 18%	1487 ac. 82%
Fire Regime IV: 35 to 200 year frequency, high replacement severity		
Condition Class Level 1	Condition Class Level 2	Condition Class Level 3
<1 ac. 0%	81 ac. 40%	123 ac 60%

Fire Regime I: Frequent Fires (0-35 years), surface to mixed burn severity		
Fire Regime V: > 200 year frequency, any severity		
Barren	Condition Class Level 2	Condition Class Level 3
<1 ac.2%	28 ac. 72%	10 ac. 26%

The data from DLH shows that 4,783 acres or 88 percent of the project is in Fire Regime I, Condition Class Level 3 and 1,487 acres in Fire Regime III Condition Class Level 3. The high vegetation departure is due to the fire return interval in the area being greater than the historical fire return interval.

Table 32: MM Summary Fire Regime and Condition Class Acres

Fire Regime I: Frequent Fires (0-35 years), surface to mixed burn severity		
Condition Class 1- low vegetation departure	Condition Class Level 2- moderate vegetation departure	Condition Class Level 3- high vegetation departure
<1 ac. 0%	58 ac. 2%	2,646 ac. 89%
Fire Regime III: 35 to 100 year frequency, low to mixed burn severity		
Condition Class Level 1	Condition Class Level 2	Condition Class Level 3
0 ac. 0%	117 ac. 4%	144 ac. 5%

The differences between the current conditions and reference conditions has created existing conditions in both project areas favoring wildfire activity, if started, that would result in more severe effects to ecosystem components than should occur under the natural fire regime for a majority of the project area. The introduction of thinning and prescribed fire would improve the VCC rating for those areas that deviate from the historical fire regime.

The deviation between the current and historical intervals has created existing conditions in both project areas favoring wildfire activity, if started, that would result in more severe effects to ecosystem components than should occur for the natural fire regime.

Table 33 and Table 34 describe the existing conditions based off stand data and modeling outputs for canopy base height, dead and down (tons/acre), canopy bulk density, percent canopy closure, stems per acre, flame lengths (wildfire scenario, includes surface and canopy fuels) and potential emissions from smoke (wildfire conditions). The existing conditions modeling outputs may differ from the Silviculture Report due to differences in averaging outcomes (trees per acre and canopy cover).

Table 33: Existing Conditions for DLH project area (2013)

Existing Conditions (2013)	Canopy Base Height (ft.)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Potential Wildfire Scenario Flame Length (ft.) (surface+canopy fuels)	Potential Smoke Emission (PM2.5) (lbs./tons consumed)
Goshawk Nest Stands	3.0	6.2	0.07	71	594	75.1	0.10
MSO Nest Stands	6.5	29.1	0.19	64	1951	98.2	0.21
MSO Nest Roost Recovery Stands	2.6	58	0.25	70	2583	132.9	0.38
MSO PAC Stands	10.8	21	0.11	68	650	82.8	0.17
Ponderosa Pine (Goshawk Foraging and PFA outside MSO)	14.6	7.4	0.07	66	260	56.7	0.12
Schultz MSO Nest Stands	6.5	29	0.19	67	1952	98.2	0.21

Table 34: Existing Conditions for MM project area (2013)

Existing Conditions (2013)	Canopy Base Height (ft)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Potential Wildfire Scenario Flame Length (ft.) (surface+canopy) fuels)	Potential Smoke Emission (PM2.5) (lbs./tons consumed)
*Mixed Conifer	10	40	0.20	64	1164	59	0.41
Ponderosa Pine	9	13	0.09	69	1281	52	0.20
*Includes wet and dry mixed conifer to include MSO Pac and Nest Cores							

Measurements of existing height to live crown, dead and down fuel (tons per acre), percent canopy closure, fuel type, and stems per acre were collected during stand exams, and fire regime condition classes and fuel modes were calculated using LANDFIRE and FVS. Flame lengths produced under existing conditions were determined using the FFE (Fire and Fuels) Extension in FVS, modeled under 97th percentile conditions. As mentioned, the fuel moisture and weather characteristics used to model the effects and behavior of a potential wildfire for existing and desired conditions are conditions under 97th percentile and conditions observed on the Schultz fire on June 20th, 2010 (see the Methodology section for more information).

According to the modeling outcome, flame lengths under existing conditions for the majority of both project areas would exceed 4 feet. Flame lengths greater than 4 feet usually require these fires to be initially attacked using mechanical equipment such as dozers or aerial resources such as helicopters and air tankers. Modification of existing conditions that would lower potential flame lengths to approximately 4 feet if a wildfire occurred would make it more feasible for initial attack forces to control such a wildfire starting under 97th percentile and Schultz fire weather conditions.

Modeling also showed that other forest characteristics contribute to creating severe fire effects and behavior in the project areas if a wildfire was to start under dry, hot, and windy weather conditions. Canopy closures greater than 50 percent and low crown base heights (less than about twenty feet) contribute to considerable tree torching, spotting as much as a mile ahead of an intense surface fire and in some cases, crown fire spread. These fire behavior conditions would inevitably create a fire situation in which fire spread would be difficult to attack and control with ground forces within one operational shift (typically 12 hours).

Modeling crown fire potential in the DLH area under both 97th percentile and Schultz fire conditions are shown in Figure 38. Under 97th percentile conditions, 73 percent of the area would experience active crown fire, 8 percent passive crown fire and 19 percent surface fire. Under Schultz conditions, modeling shows 51 percent of the area would experience active crown fire, 10 percent passive crown fire and 39 percent surface fire behavior.

Modeling crown fire potential within the MM area under the same parameters is as follows: 97th percentile equates to 74 percent active crown fire, 16 percent passive and 10 percent surface. Schultz conditions would be 70 percent active crown fire, 24 percent passive crown fire and 6 percent surface fire. Figure 38, Figure 41 and Figure 42 show the existing condition crown fire potential in the DLH and MM areas, modeled under Schultz Wildfire weather conditions.

Figure 38: Crown Fire Potential under 2010 Schultz Wildfire and 97th Percentile Weather Conditions for DLH and MM

97th Percentile Weather Conditions	2010 Schultz Fire Weather Conditions

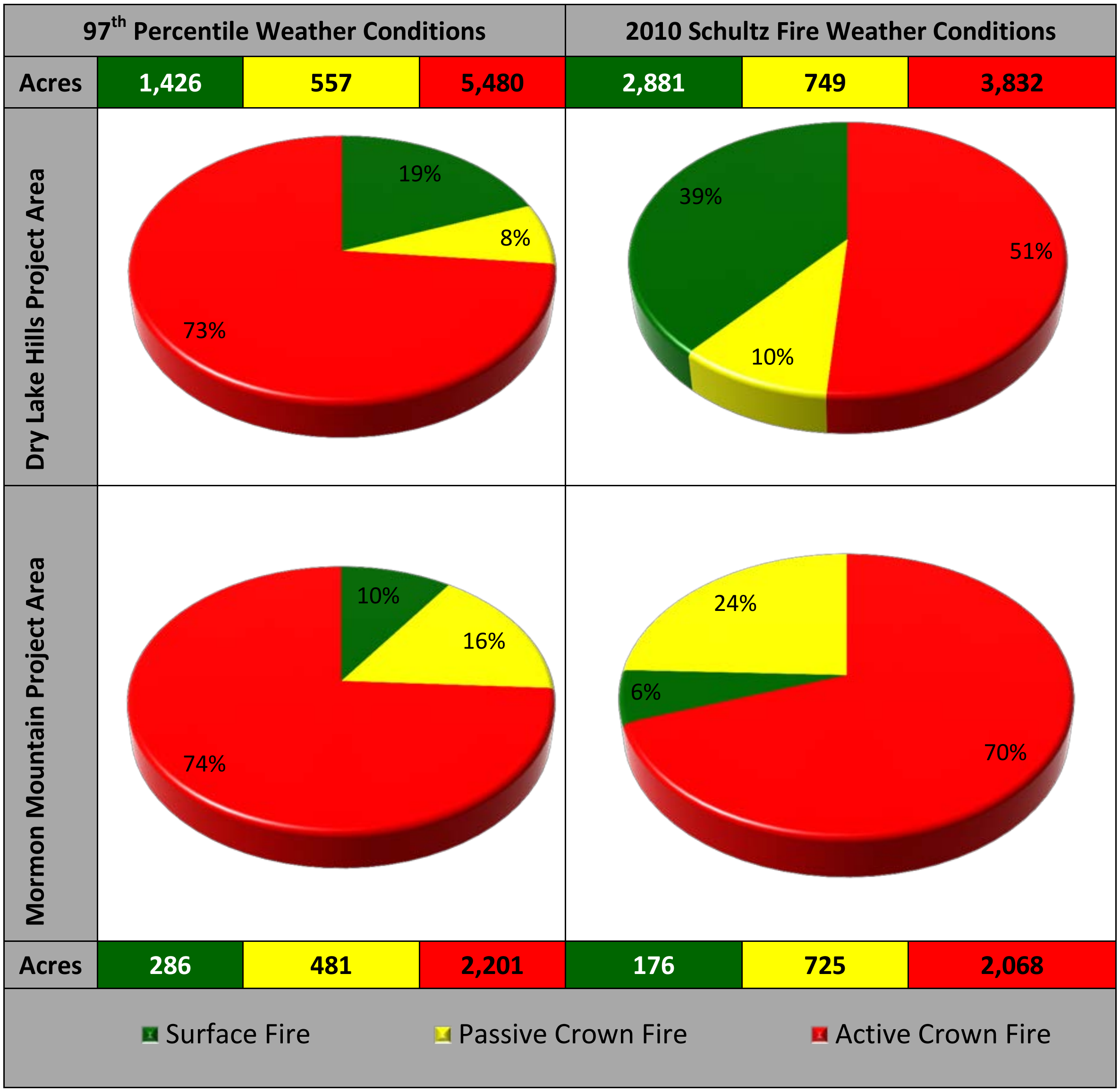


Table 35 displays the estimated arrival time of the modeled fires in hours. For example, if a fire were to start at the Intersection of FR 420 and FR 557 (the Y). Under modeled conditions the fire would burn approximately 51acres in the first hour and 2,803acres within the first 5 hours. Arrival time and ignition locations are identified in the Methodology section and in the fire spread maps discussed in each alternative analysis below.

Table 35: Arrival time in acres/hour under the Existing Condition (No Action Alternative)

Arrival Time	Intersection of FR 420 and 557	Intersection of FR 557 and Oldham Trail	Paradise	FR 648 (Mormon Mountain)
1st Hour	51 acres	469 acres	259 acres	197 acres
2nd Hour	318 acres	1411 acres	1217 acres	607 acres
3rd Hour	960 acres	2414 acres	2012 acres	1003 acres

Arrival Time	Intersection of FR 420 and 557	Intersection of FR 557 and Oldham Trail	Paradise	FR 648 (Mormon Mountain)
4th Hour	1604 acres	3482 acres	2773 acres	1614 acres
5th Hour	2803 acres	4156 acres	3438 acres	2508 acres

Environmental Effects

Effects Common to All Action Alternatives

There are many components that influence fire behavior. In order to address how to change the influence of these components on fire behavior within a stand and/or over a landscape, an explanation of how thinning and burning activities can affect these different components and thereby fire behavior has been provided here.

Dead and down fuel loading directly effects flame length and duration. A large amount of dead and down fuel on the ground produces longer flame lengths for a longer period of time during hot, dry conditions as compared to a low amount of dead and down surface fuel loading. Longer flame lengths and burning durations also increase the risk or potential for fire to transition into the crown or forest canopy, especially if crown base heights within the stand are low.

Periodic prescribed burning can reduce expected flame lengths by burning surface fuels initially and then maintaining a low dead and down fuel loading in subsequent burns. For prescribed fire to be effective and safe within the project area, the continuity of fuels would need to be reduced in advance of burning. Therefore, thinning stands before burning helps create a safer environment in which to implement prescribed fire. Decreasing canopy closure and crown bulk density can increase the canopy base height if many small trees exist in the understory and the majority of those small understory trees are cut.

The height to the bottom of live crown (crown base height) directly affects how easily a fire torches trees, producing firebrands, and how easily a fire transitions into a crown fire. The number of tree stems per acre also affects how easily a fire is able to transition into a crown fire by not providing the fire with burnable material, but also allowing heat to accumulate more easily under the canopy. Thinning from below increases height to bottom of live crown, decreases the number of stems per acre, opens up the canopy, and allows heat created by burning surface fuels to be dispersed more readily. All of these actions reduce the ease with which a fire can “torch” trees and/or transition to a crown fire and produce firebrands that create/ignite spot fires.

Lastly, by both thinning and burning, stands can reach conditions that are closer to the natural historic fire regime of vegetation characteristics, fuel composition, fire frequency, severity, and pattern. This can be achieved by thinning and prescribed burning at appropriate burn intervals. The combination of thinning and then prescribed burning in intervals should help stands that currently have FRCC/VCCs of three and fire hazard ratings of *extreme* to *high* to reach FRCC/VCCs of one or two and fire hazard ratings of *moderate* to *low* over time.

Alternative 1: No Action

Direct & Indirect Effects

Ground Fuels and Vegetation

No fuel reduction and no change in vegetative structure of the forest within the FWPP area would occur under the No Action Alternative, with the exception of the areas that could be implemented under the Jack Smith Schultz and Eastside project decisions. This alternative would not reduce the existing fire hazard within the project area. Not implementing fuel treatments including thinning and prescribed burning would encourage a greater departure from historic fire severity and frequency. These conditions would persist because fuel loading would continue to accumulate on the forest floor without the reduction of these fuels by low intensity, high frequency fires mimicked by periodic prescribed burning consisting of three to seven year burn intervals. Also without thinning, the number of trees per acre would continue to rise both in the forest and in areas that were historically grasslands/meadows, thus increasing the continuity of fuels and the area that would be impacted by high-severity wildfire.

Without periodic prescribed burning, crown base heights would also continue to remain low. As more trees grow within the project area, low crown base heights result in more crown ladder fuels and with them, in addition to greater crown bulk densities, an increased potential for passive and active crown fires to occur within the forested stands of the project area during hot, dry weather conditions.

High intensity, stand replacing fire would initially reduce the dead and down fuel within the project area, but it would do so at the cost of negatively altering existing ecosystem condition and diversity (vegetation, wildlife, soils, watershed, etc) and damaging heritage resource sites. The existing conditions would not be improved, and the majority of the project area would retain the potential for active conditional crown fi[24]re (Figure 38, Figure 41 and Figure 42). Also, as time goes by, more dead and down woody fuel would increase, potentially increasing fire hazard over time as dead trees and other dead fuels produced in the stand replacing fire fall to the forest floor (Greenlee and Greenlee 2002).

Fire Suppression Efforts

Under this alternative a wildfire would likely produce flame lengths in excess of four feet (Table 33 and Table 34) over the majority of the project area. Initial attack of these fires would usually require using mechanical equipment such as dozers or aerial resources such as helicopters and air tankers. If a wildfire occurred under this alternative, it would be difficult for initial attack forces to control in the first operational period. Wildfires in the wildland/urban interface place particularly high demands on emergency response personnel, and such a fire would threaten multiple structures and multiple groups of people in a very short span of time. Firefighting resources are deployed when human life is immediately at risk or there is a clear emergency, thus leaving fewer personnel to actually bring the fire under control. This generally results in larger wildfires and greater resource damage to the National Forest and surrounding areas.

Wildfire Hazard Potential

[24] Conditional crown fire: a crown fire that moves through the crown of trees but is not linked to a surface fire

Another effect of the No Action Alternative would be the increased potential for a wildfire to become established and burn with sufficient intensity to exceed the capability of emergency response personnel (see fire arrival times in Figure 39 and Figure 40).

Figure 39: Estimated Fire Arrival Time for Alternative 1 DLH, modeled under Schultz Fire weather conditions

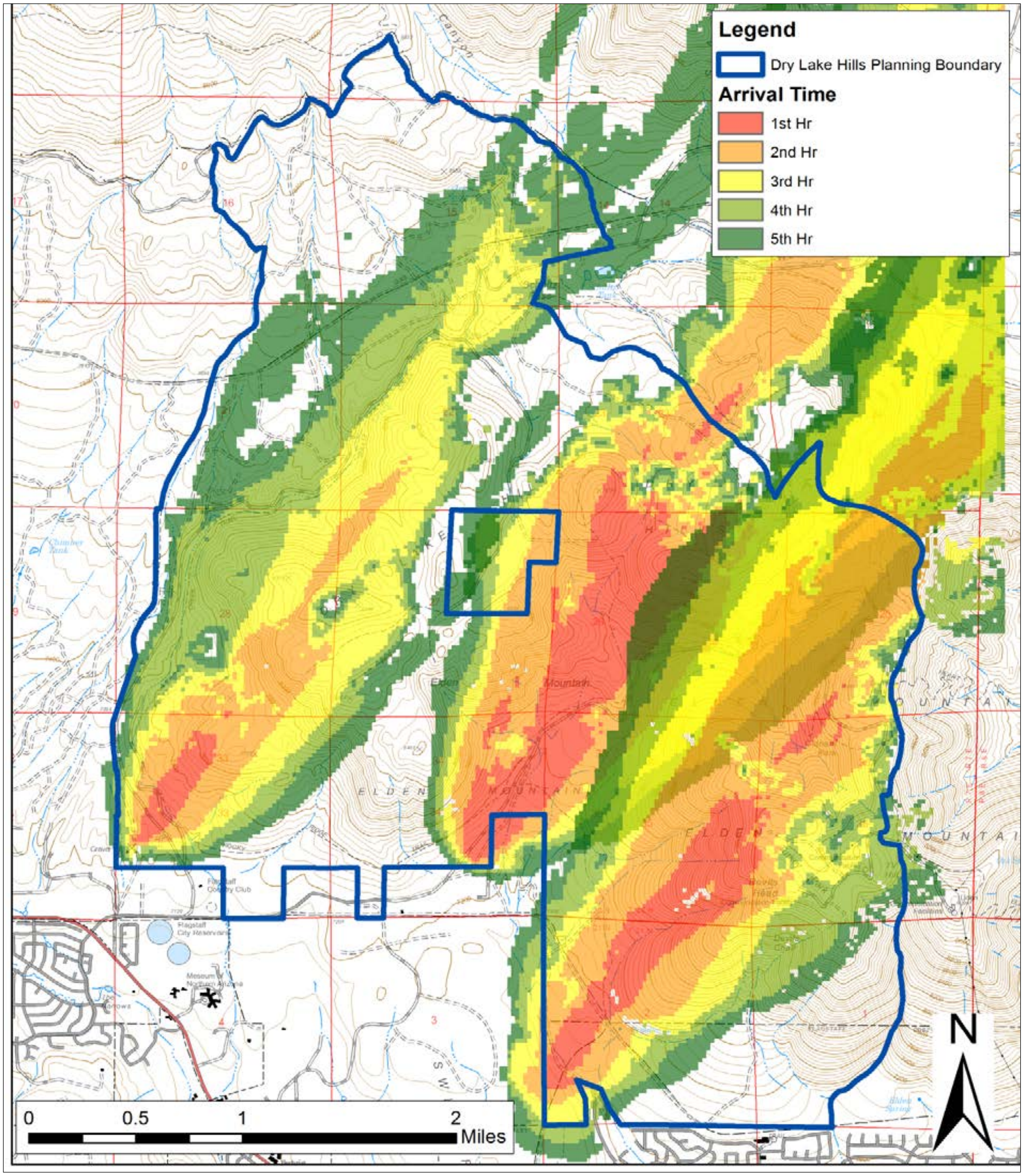
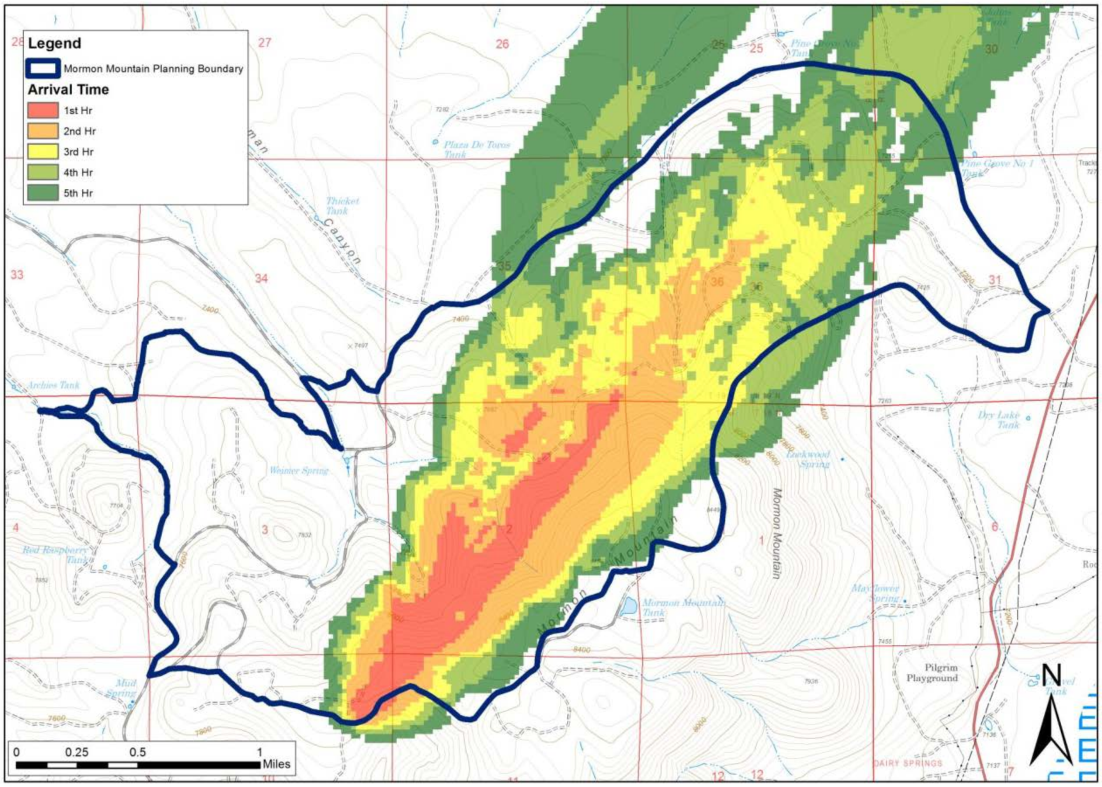


Figure 40: Estimated Fire Arrival Time for Alternative 1, MM, modeled under Schultz Fire Weather Conditions



Most of the area surrounding the project area provide several popular recreational opportunities for the forest visitor, such as camping, hiking, scenic viewing, hunting, and riding ATV and/or UTVs and is highly visited throughout the year although more so during the summer and fall months. Recreationists tend to build campfires during their stay in the forest; some fires are started in established campfire rings and others in temporary campfire rings. Many times these fires are left unattended or do not get properly extinguished and escape from the ring. Prevailing winds during the year are mostly out of the southwest. If a campfire escapes in or near the project area during hot, dry, windy weather conditions, this escaped fire could pose a threat to the FWPP project areas. The No Action Alternative would not include a permanent campfire closure order for the DLH portion, and also would not decommission any closed Forest Roads; thereby campfires and illegal public access could still occur, and the threat of human-caused fires would remain.

Finally, Alternative 1 leaves much of the area in extreme and very high fire danger as well as Condition Class III (a severe departure from the natural historical regime of vegetation characteristics, fuel composition, fire frequency, severity and pattern). As time passes, even more area would transition to a Condition Class III and further result in destructive wildfires more severe than the area's historic fire regime.

Table 36 and Table 37 represent the existing conditions and anticipated conditions in twenty years under the No Action Alternative.

Table 36: DLH average projected conditions in treatment areas under the No Action Alternative

Alt. 1 Projected Conditions Dry Lake Hills *(No Action)* No Treatment 2017 No Treatment 2033	Canopy Base Height (ft)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Potential Wildfire Flame Length (ft)	Potential Wildfire Smoke Emission (PM2.5) (lbs/tons consumed)
Goshawk Habitat (2017)	3	7	0.07	71	583	14	0.14
Goshawk Habitat (2033)	4	10	0.08	74	534	20	0.17
MSO PAC Habitat (2017)	12	19	0.10	69	610	39	0.20
MSO PAC Habitat (2033)	13	21	0.12	71	543	37	0.23
MSO Nest Core (2017)	8	22	0.11	57	546	33	0.20
MSO Nest Core (2033)	9	28	0.15	67	516	49	0.22
MSO Nest Roost Habitat (2017)	3	58	0.24	70	2947	86	0.40
MSO Nest Roost Habitat (2033)	3	58	0.25	73	2386	93	0.46
Ponderosa Pine (2017)	16	8	0.7	67	254	10	0.11
Ponderosa Pine (2033)	18	10	0.7	69	231	10	0.12

Table 37: MM average no action alternative projected conditions in treatments areas under the No Action Alternative

Alt. 1 Projected Conditions Mormon Mountain (No Action) No Treatment 2017 No Treatment 2033	Canopy Base Height (ft)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Potential Wildfire Flame Length (ft)	Potential Wildfire Smoke Emission (PM2.5) (lbs/tons consumed)
*Mixed Conifer (2017)	9	40	0.2	64	1153	62	0.43
*Mixed Conifer (2033)	10	45	0.19	71	975	69	0.49
Ponderosa Pine (2017)	8	14	0.9	61	1198	55	0.16
Ponderosa Pine (2033)	11	17	0.11	69	919	57	0.18
*Includes wet and dry mixed conifer, to include MSO PAC's and Nest Cores							

Under the No Action Alternative, a wildfire would produce flame lengths exceeding 4 feet over most of the project area, making it difficult and unsafe for initial attack crews to control a wildfire occurring under modeled conditions. The average surface flame lengths under Schultz Fire weather conditions commonly range from 10 to 93 ft. (including canopy fuels) over all treatment areas. When looking at existing conditions of stands according to fuel model distinction, many areas have flame lengths that could potentially reach more than 50+ feet (including canopy fuels). These averages seem to be consistent considering many individual stands within treatment areas consist of as much as 10 to 60 tons per acre of down and dead woody debris. Furthermore, canopy closure exceeds 60 percent in many stands and canopy bulk density is well above 0.02(kg/M^3) in most stands.

Figure 41: Existing Conditions (No Action Alternative) fire behavior modeled under 2010 Schultz Wildfire weather conditions – Dry Lake Hills

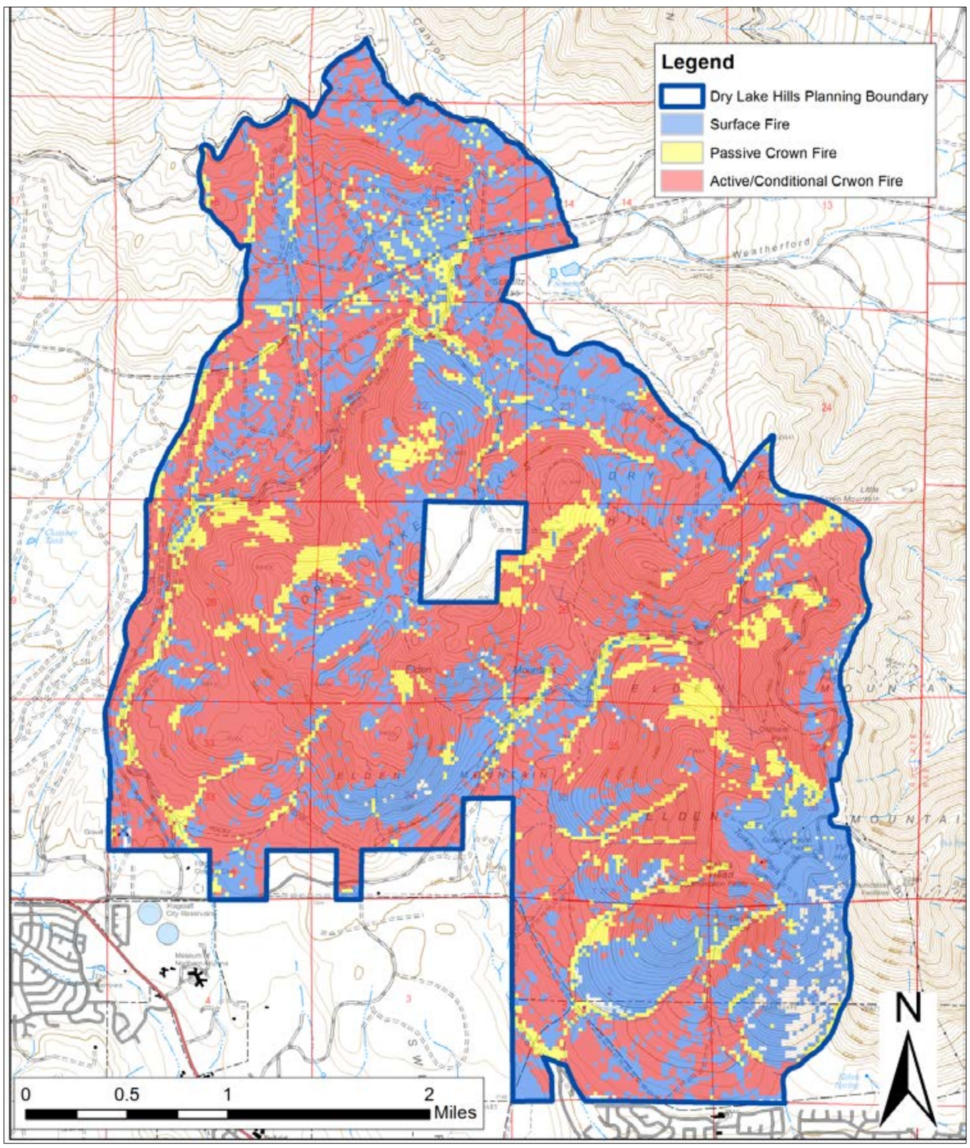
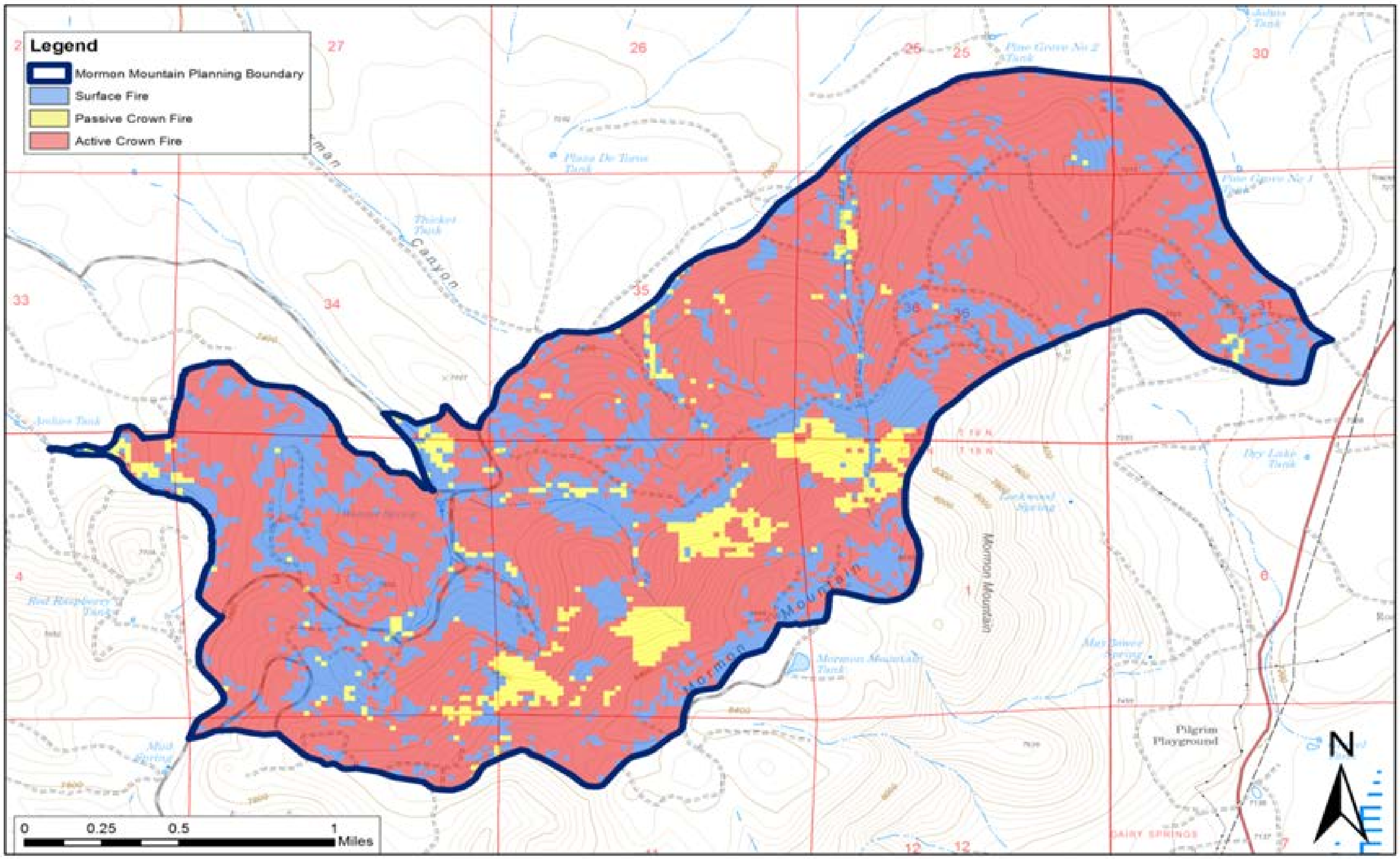


Figure 42: Existing Conditions (No Action Alternative) Fire behavior modeled under 2010 Schultz Wildfire weather conditions – Mormon Mountain



Cumulative Effects

The cumulative effects boundary for this project is the Flagstaff Ranger District, as this encompasses most of the forested land subject to the prevailing winds driving a wildfire into the community of Flagstaff and the surrounding areas. The project areas (DLH and MM) are within the Flagstaff Community Wildfire Protection Plan area (CWPP) the treatments proposed are in line with the goals and objectives set forth by the CWPP.

The time period analyzed for the cumulative fire effects of this project includes a twenty year period from 2013 to 2033. Prior to that time the only activities in the area that affected the fire hazard were aggressive fire suppression and the continuing growth of forest vegetation.

Implementation of the No Action Alternative, along with past, present, and reasonably foreseeable actions, may have cumulative effects relative to fire and fuel conditions within the project area.

When combined with the effects of climate change, a cumulative effect of the No Action Alternative would be an increase in the number of acres of national forest on the District that are vulnerable to severe fire effects. The vegetation type across the Coconino National Forest requires periodic fire to remain balanced. Fuel conditions have reached a point where fire effects are more severe than desired and more severe than would naturally occur. The fire hazard and fuel profile increases with time as the vegetation grows and dies.

Unavoidable Adverse Effects, Irreversible and Irretrievable Commitment of Resources

As described above, with no treatment, there would be a higher potential for large, high severity fires than occurred historically, or than are sustainable within the project area. In recent years, fires on the Mogollon Rim that have taken human lives, destroyed homes/property/infrastructure, and produced high severity effects across large areas not adapted to high severity fire include Rodeo/Chediski 2002 (469,000 acres), Wallow 2011 (538,000 acres), and Whitewater-Baldy Complex 2012 (approximately 3000,000 acres). Such fires permanently change tens of thousands of acres of forests when they burn with high severity in areas which are not adapted to high severity fire. There is broad consensus that such fires would burn in this area if there is no action taken, though the specific extent and location of the negative effects would not be known until an incident occurs. First order effects would include (but are not limited to) high levels of tree mortality across the burned area (assuming ~30 percent high severity). Second order fire effects would include (but are not limited to) destroyed infrastructure. Some of these effects would last just a few days or weeks (infrastructure would be rebuilt), some would take years to recover, some changes would be permanent (Savage and Mast 2005).

Direct and Indirect Effects Common to Alternatives 2 & 3

Alternative 2 and 3 have similar desired outcomes with slight differences in harvesting methods. Effects to ground fuels and vegetation, fire suppression efforts, and wildfire hazard potential (not including canopy fire potential and anticipated prescribed fire effects) are the same between the two alternatives, and are discussed here. Those differences in effects are discussed separately under each alternative.

Ground Fuels and Vegetation

Direct effects of Alternatives 2 and 3 would be consistent with other similar fuels treatment projects on the Flagstaff Ranger District: prescribed fire would reduce surface fuels, raise crown base heights, reduce stems per acre and improve stand conditions. Initial entry and maintenance prescribed fire may also result in an increase in tree mortality and reduce the amount of available logs and snags. However, with the anticipated mortality associated with prescribed burning (Table 39 and Table 40), snags and logs would be created to offset the direct effect.

Fire Suppression Efforts

Fuel reduction treatments within the wildland urban interface should reduce expected fire behavior to a level at which a small number of personnel can quickly and effectively control a wildfire. The objectives of the treatments are to reduce the possibility that wildfires can get established at sizes beyond the capacity of initial attack forces and reduce the intensity with which wildfires can burn. These reductions further reduce the probability that the demand on emergency response personnel would be exceeded and reduce the threat to life and private property. Wildfires can be controlled with fewer acres burned resulting in less damage to the National Forest and adjacent lands. Also, wildfires burn less severely resulting in less resource damage to each acre burned.

Wildfire Hazard Potential

Alternatives 2 and 3 would result in short-term increases (one to two years) in wildfire hazard potential while treatments are occurring due to dead trees and slash being produced on site. While the proposed thinning reduces crown fire ladders, canopy closure, and crown loading, the majority of the slash produced would be piled on site, temporarily increasing the dead and down fuel loading until the piles are burned within prescription. Slash treatments under the alternatives would possibly include whole tree harvesting, which consists of all woody debris being removed from the forest and therefore reducing the need for pile burning. If available, biomass utilization would also remove slash and debris from the forest, thus negating the need for pile burning and resulting in an immediate reduction in wildfire hazard potential. However, under all slash-removal options, broadcast burning would still occur prior to or within 1 to 3 years after implementation of thinning, along with maintenance burning every 5-7 years in the ponderosa pine vegetation type. This would maintain post treatment fuels conditions within those areas. Within the mixed conifer vegetation type, maintenance burning may not occur during the life of the project due to its historical fire return interval. Because of this, wildfire flame lengths and down woody debris would increase over the 20 year period for Alternatives 2 and 3 (Table 42 and Table 48.

By treating the FWPP area, the potential for a crown fire starting in the project areas and spreading as a crown fire through adjacent areas would be reduced. This treatment would further reduce the hazard of crown fire spreading to nearby urban interface areas at risk and improve this fire adapted ecosystem. Additionally, fire spread is anticipated to be slower when modeled under Schultz Fire weather conditions (Figure 43 and Figure 44).

Figure 43: Estimated Fire Progression for Alternatives 2 and 3, DLH

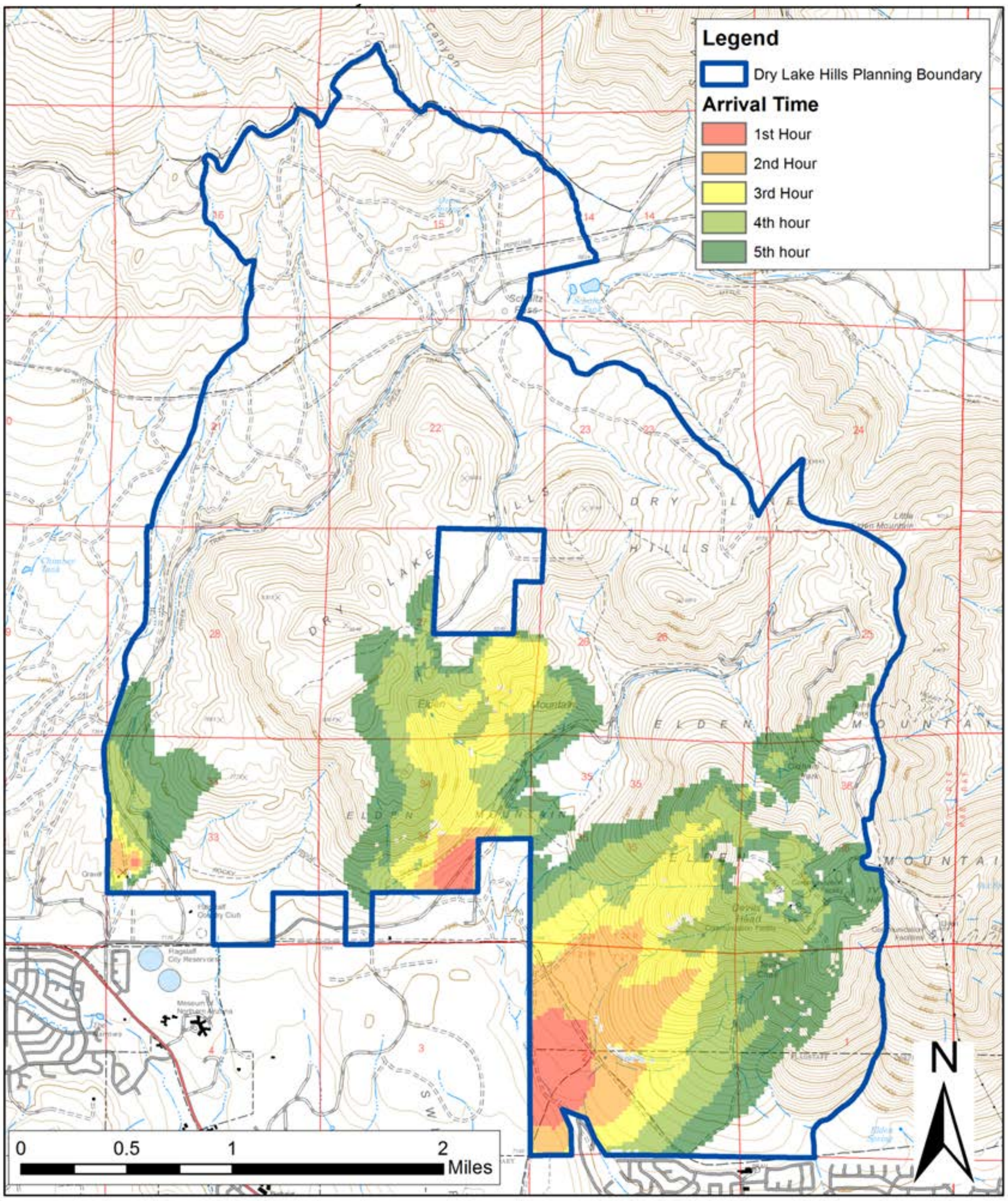
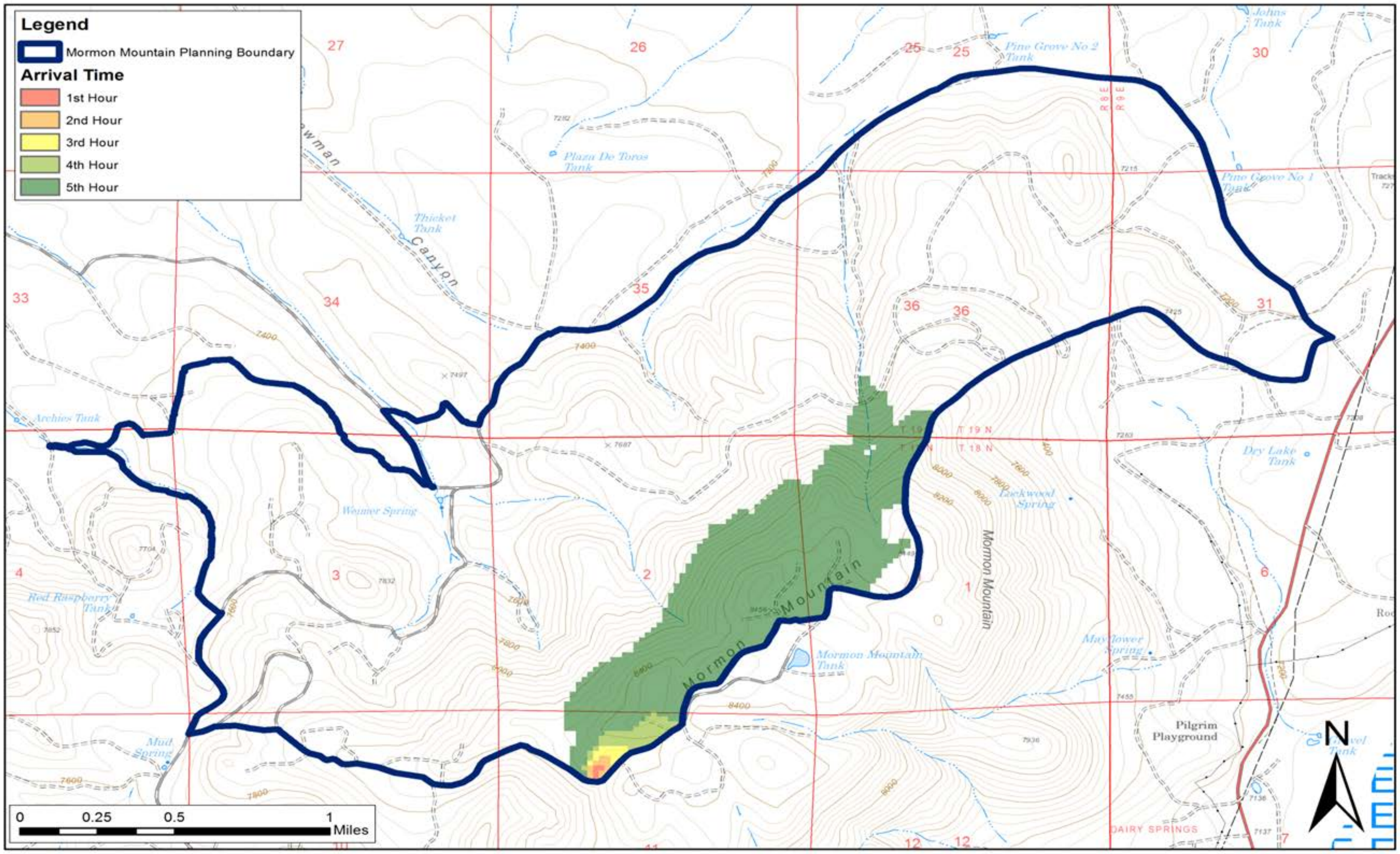


Figure 44: Estimated Fire Progression for Alternatives 2 and 3, MM



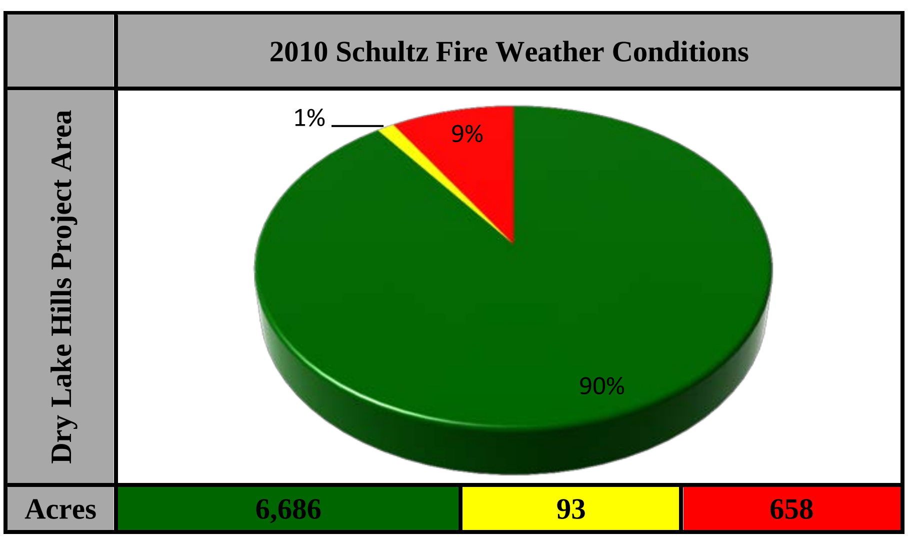
Alternatives 2 and 3 would include a permanent campfire closure order for the DLH portion and potentially the need for temporary area closures during implementation. These alternatives would also decommission approximately 4 miles of Forest Roads. This would result in a decrease in campfires and unauthorized motorized public access, thereby reducing the threat of human-caused fires within the DLH (Dickson et al. 2006).

Alternatives 2 and 3 address the purpose and need more so than Alternatives 1 (No Action) and 4 by reducing the crown bulk density (thinning), reducing the canopy closure (thinning), increasing the effective crown base height in most sites (thinning and prescribed burning over time), and reducing the number of potential firebrands and shortening the distance at which spot fires would be expected to occur (thinning and prescribed burning). Furthermore, Alternatives 2 and 3 meet the project goals and objectives because the fire hazard would be drastically reduced in the project area from extreme, very high, and high, to mostly high, moderate, and low, and overall goals for community protection and resource protection would be met compared to the results of the No Action Alternative.

Crown Fire Potential

Crown fire potential for DLH modeled under Schultz conditions shows active crown fire on 658 acres, passive crown fire on 93acres and 6,686 acres of surface fire (Figure 45 and Figure 46). Crown fire potential for MM modeled under Schultz conditions shows active crown fire on 63 acres, passive crown fire on 329 and 2,577 acres of surface fire (Figure 45 and Figure 47). Due to consistency in treatments between Alternatives 2 and 3, the two alternatives were modeled using the same post-treatment condition data set. Under Alternative 3, there may be a slight increase in passive/active crown fire related to an increase in residual dead and downed fuel; however, this increase is negligible in the scope of modeling.

Figure 45 Modeled crown fire potential Alternatives 2 and 3



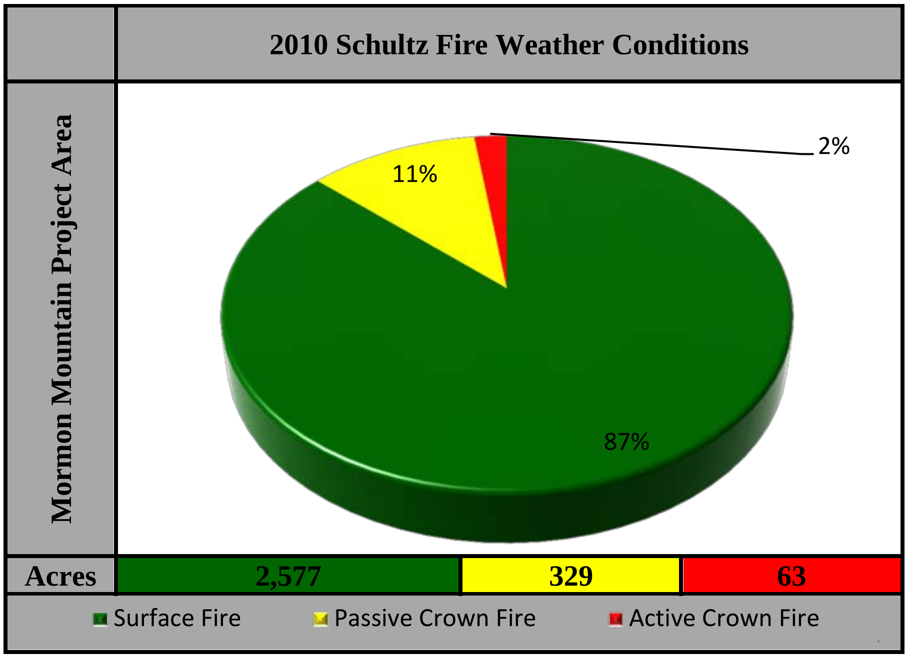


Table 38: Crown Fire potential Alternatives 2 and 3

Dry Lake Hills	**Existing Crown Fire Potential (97th %)**	**Existing Crown Fire Potential Schultz**	**Alternative 2 & 3 Schultz conditions**
Active	5,480 acres	3,832 acres	658 acres
Passive	557 acres	749 acres	93 acres
Surface	1,426 acres	2,881acres	6,686 acres
Mormon Mountain	**Existing Crown Fire Potential (97th %)**	**Existing Crown Fire Potential Schultz**	**Alternative 2 & 3 Schultz conditions**
Active	2,201 acres	2,068 acres	63acres
Passive	481 acres	725 acres	329 acres
Surface	286 acres	176 acres	2,577 acres
*Differences between 97th percentile conditions and Schultz are negligible, therefore only post treatment conditions under Schultz are listed.			

Crown fire potential as modeled for Alternatives 2 and 3 for the DLH unit under Schultz conditions shows a reduction of crown fire potential from 3,832 to 658 acres of active crown fire, 749 to 93 acres passive crown fire and 2,881 to 6,686 acres of surface fire behavior.

Crown fire potential as modeled for Alternatives 2 and 3 for the MM unit under Schultz conditions shows a reduction of crown fire potential from 2,608 to 63 acres of active, 725 to 329 acres of passive crown fire and 176 to 2,577 acres of surface fire behavior

Figure 46: Alternatives 2 and 3 fire behavior post-treatment, modeled under 2010 Schultz Wildfire weather conditions – DLH

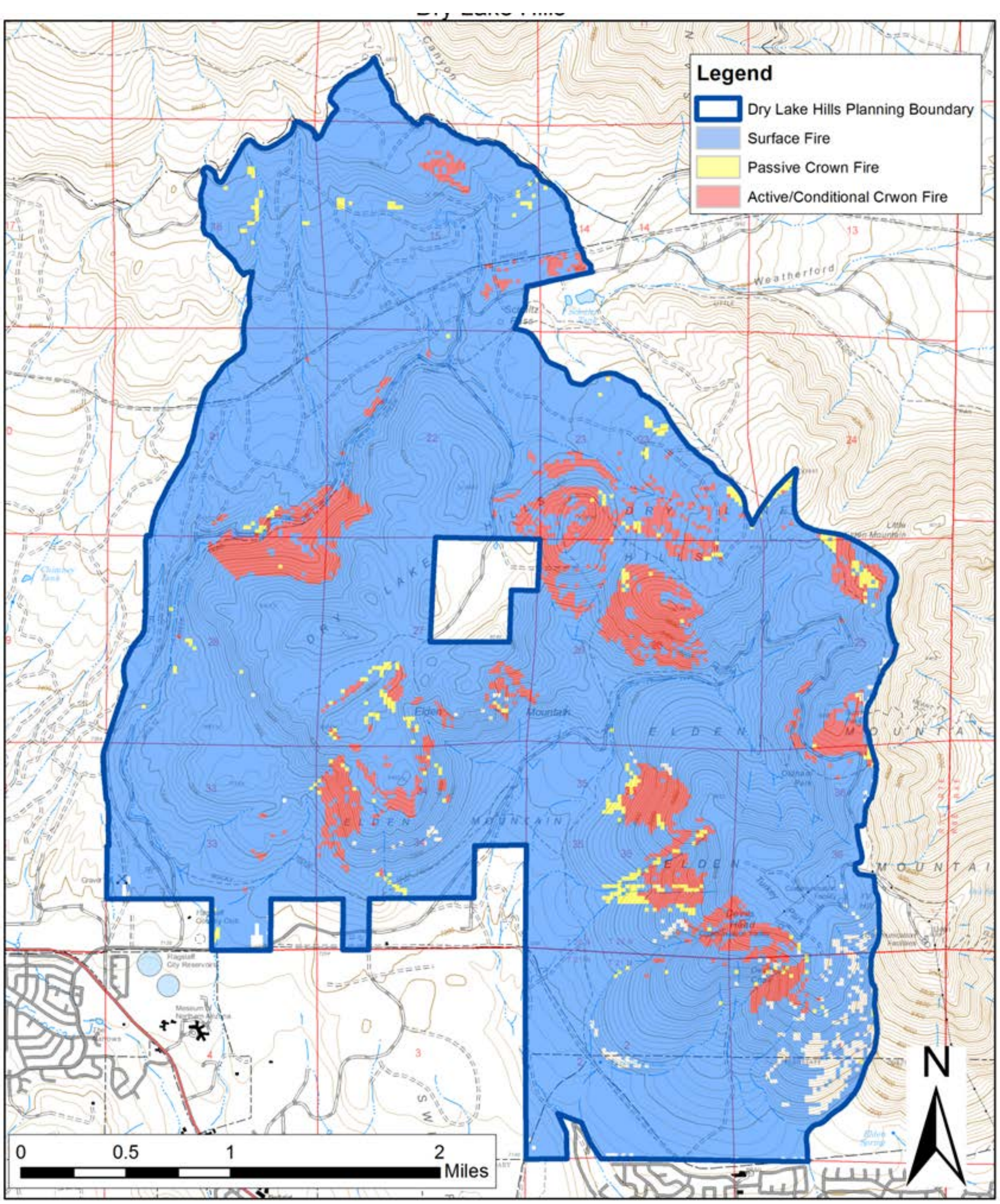
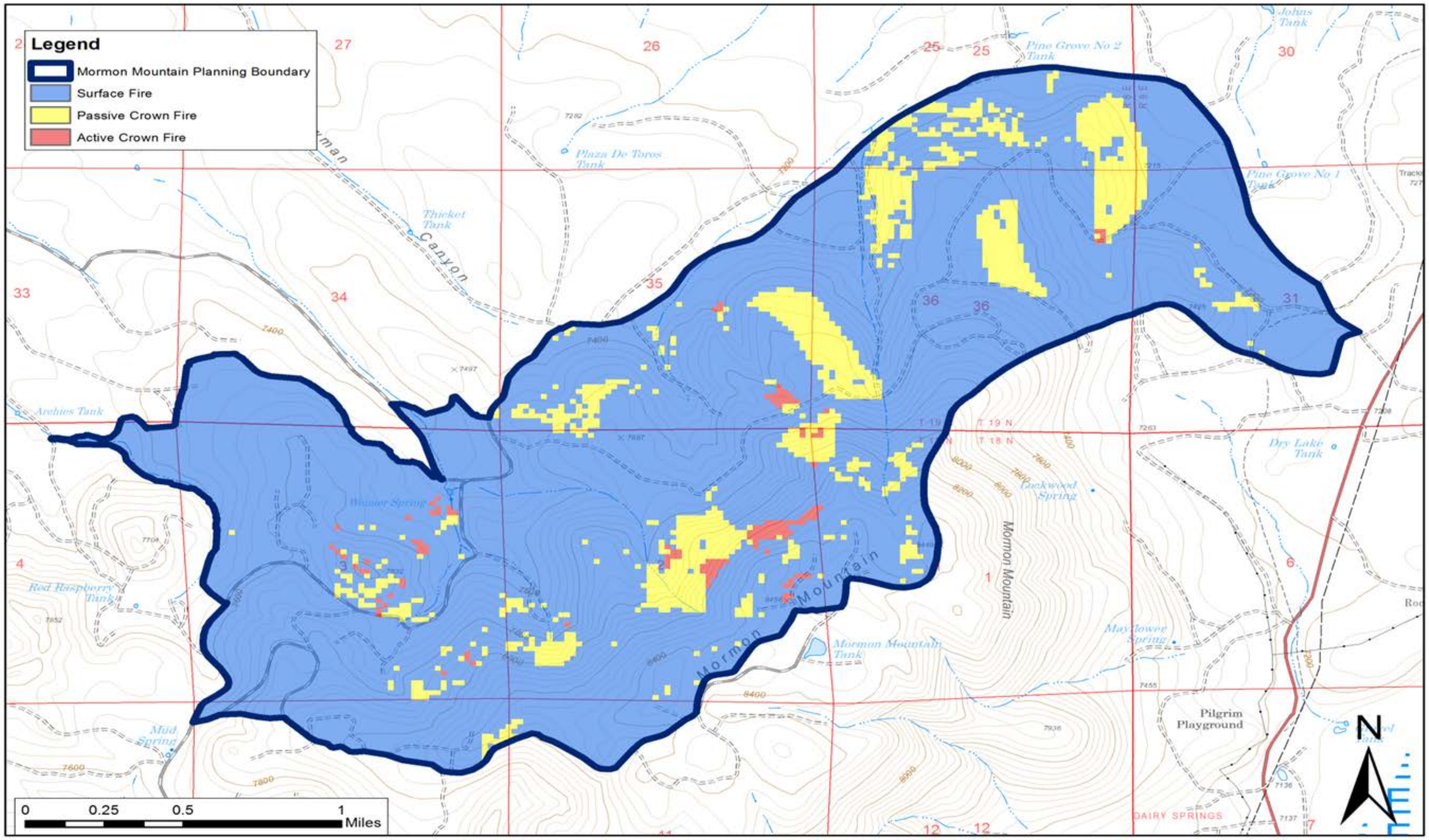


Figure 47: Alternatives 2 and 3 fire behavior post-treatment, modeled under 2010 Schultz Wildfire weather conditions – MM



Alternative 2: Proposed Action with Cable Logging

The DLH area includes approximately 7,569 acres; 836 acres are currently being treated under the Jack Smith Schultz project and roughly 769 acres are either non-treatable due to rock faces and/or boulder fields. Under Alternative 2, treatments in the DLH would include mechanical and hand thinning as well as prescribed fire on the remaining acres (approximately 5,963 acres), with the use of cable logging to remove cut material from steep, inaccessible slopes on approximately 1,185 acres.

The MM area includes approximately 2,974 acres. Treatments would include mechanical and hand thinning as well as prescribed fire with approximately 106 acres of cable logging proposed.

Alternative 2 also proposes prescribed burning in the wet mixed conifer in the MM area. Burning techniques in the wet mixed conifer would target accumulated dead and down material rather than usual broadcast burning ignition patterns.

Direct and Indirect Effects

As discussed under Direct and Indirect Effects Common to Alternatives 2 and 3, the majority of effects between these two action alternatives would be the same. Therefore, only the differences are discussed here and under Alternative 3.

Prescribed fire would include initial pile burning to remove slash accumulated through harvesting, followed by broadcast burning. Within the ponderosa pine vegetation type, maintenance burning may occur every five to seven years following implementation in order to maintain lower fuel loading levels and to restore a frequent, low-severity fire regime. Mixed conifer stands may only receive one broadcast burn through the life of the project due to the historic Fire Return Interval. Effects of target burring accumulated dead and down fuels in wet mixed conifer would result in a decrease of available fuel loading that would otherwise be left and could potentially increase the likelihood of crown fire initiation. Other slash removal options as described in the Implementation Methods section could also be used in lieu of burning, including biomass removal.

Table 39 and Table 40 represent prescribed fire implementation effects by treatment types.

Table 39: Prescribed Fire Implementation Effects Dry Lake Hills ALternative 2

Alt.2 Prescribed Fire Implementation Effects by Treatment	Flame Length (ft.)	Scorch Height (ft.)	Smoke Emission (PM2.5)	Mortality (BA Killed)	Post Burn DWD 12+ (tons/acre)
Electronic Site – Structure Protection	**Not Modeled				
Grassland Restoration	**Not Modeled				
Ponderosa Pine Fuels Reduction - Hand Thin	**Not Modeled				
Aspen Treatment - Hand Thin	**Not Modeled				
Mixed Conifer - Hand Thin	3.8	22.8	0.14	10.4	7.8

Alt.2 Prescribed Fire Implementation Effects by Treatment	Flame Length (ft.)	Scorch Height (ft.)	Smoke Emission (PM2.5)	Mortality (BA Killed)	Post Burn DWD 12+ (tons/acre)
MSO PAC - Hand Thin	3.7	22.1	0.1	4	14.9
Burn Only	4.9	30.6	0.08	19.4	2.7
Nest Core Burn Only	4.2	25.9	0.04	7.4	0.4*
Goshawk PFA MC Fuels Reduction GB	4	24.1	0.07	4.5	2.9
MSO PAC Fuels Reduction GB	2.6	12.5	0.09	4.4	7.8
MSO PAC Fuels Reduction Cable	2.6	12.6	0.1	3.8	8.8
Goshawk PFA PP Fuels Reduction GB	3.3	16.3	0.06	3.1	0.3*
Goshawk PFA Fuels Reduction Cable	3.2	15.9	0.09	4.6	1.1
Goshawk Nest Fuels Reduction	2.6	11.1	0.07	3.6	1.1
Schultz Nest - Hand Thin	3.6	21.1	0.1	15.8	15.8
Mixed Conifer Fuels Reduction GB	4.1	24.5	0.12	4.8	8
Mixed Conifer Fuels Reduction Cable	3.9	23.1	0.07	1.3	2.7
Ponderosa Pine Fuels Reduction GB	3.1	13.9	0.08	5	0.6*
Ponderosa Pine Fuels Reduction Cable	3.6	18.8	0.08	3.8	1.3
* Pretreatment values were less than 1 ton/acre for downed woody debris larger than 12", ** Stands not modeled due limited stand level data.					

Table 40: Prescribed Fire Implementation Effects Mormon Mountain Alternative 2.

Alt.2 Prescribed Fire Implementation Effects by Treatment	Flame Length (ft)	Scorch Height (ft)	Smoke Emission (PM2.5) (tons	Mortality (BA Killed)	Post Burn DWD 12+ (tons/acre)
Electronic Site - Structure Protection	**Not Modeled				
MSO Nest Mixed Conifer-Burn Only	1.8	7	0.18	9.1	7.1
MSO Nest Ponderosa Pine -Burn Only	2.2	10.2	0.09	11.6	0.3*
MSO Nest / Roost Recovery	3.7	21.5	0.11	11.7	1.0*
MSO PAC MC Fuels Reduction (Cable)	2.4	10.2	0.2	8.2	11.4
MSO PAC MC Fuels Reduction (Ground Based)	2.1	8	0.16	7.6	7.8
MSO PAC PP Fuels Reduction (Cable)	2.9	13.9	0.9	4.9	0.8*
MSO PAC PP Fuels Reduction (Ground Based)	2.9	14.2	0.1	3.8	0.8*
MSO PAC Fuels Reduction - Wet MC	4.5	24.8	0.24	33.9	14

Alt.2 Prescribed Fire Implementation Effects by Treatment	Flame Length (ft)	Scorch Height (ft)	Smoke Emission (PM2.5) (tons	Mortality (BA Killed)	Post Burn DWD 12+ (tons/acre)
Ponderosa Pine Fuels Reduction Pine/Oak	2.3	8.9	0.1	6.9	0.3*
* Pretreatment values were less than 1 ton/acre for downed woody debris larger than 12", ** not modeled due to no stand data.					

Table 41 and Table 42 represent post mechanical treatments and modeled wildfire conditions if a fire were to start and burn through the project areas under Schultz fire conditions.

Table 41: Dry Lake Hills average for Alternative 2 projected post-treatment conditions.

Alt. 2 Projected Conditions Dry Lake Hills Post-Treatment 2017 Post-Treatment 2033	Acreage	Canopy Base Height (ft.)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Post-treatment Wildfire Flame Length (ft.) (surface+crown fuels)	Potential Post-Treatment Wildfire Smoke Emission (PM2.5) (lbs/tons consumed)
Electronic Site – Structure Protection	6	**Not Modeled						
Grassland Restoration	60	**Not Modeled						
Ponderosa Pine Fuels Reduction - Hand Thin	150	**Not Modeled						
Aspen Treatment - Hand Thin	22	**Not Modeled						
Mixed Conifer - Hand Thin (2017)	132	23	15	0.05	50	112	7	0.17
Mixed Conifer - Hand Thin (2033)		23	19	0.06	55	107	7	0.17
MSO PAC - Hand Thin (2017)	202	22	20	0.04	55	82	6	0.12
MSO PAC - Hand Thin (2033)		23	23	0.04	56	75	6	0.13
Burn Only (2017)	270	19	10	0.5	53	140	15	0.13
Burn Only (2033)		**24**	17	0.55	57	129	16	0.14
Nest Core Burn Only (2017)	261	23	4	0.05	52	114	8	0.08
Nest Core Burn Only (2033)		**28**	10	0.05	53	102	8	0.10
MSO PAC Fuels Reduction GB (2017)	1167	23	13	0.04	54	307	7	0.11
MSO PAC Fuels Reduction GB (2033)		13	17	0.05	58	297	14	0.13
MSO PAC Fuels Reduction Cable (2017)		21	21	0.04	54	281	9	0.08
MSO PAC Fuels Reduction Cable (2033)		5	18	0.04	58	271	17	0.10
Goshawk PFA MC Fuels Reduction GB (2017)	100	24	7	0.04	50	200	7	0.09
Goshawk PFA MC Fuels Reduction GB (2033)		2	11	0.04	55	192	21	0.11
Goshawk PFA PP Fuels Reduction GB (2017)		29	4	0.02	49	106	4	0.05

Goshawk PFA PP Fuels Reduction GB (2033)		25	7	0.02	52	99	4	0.07
Goshawk PFA Fuels Reduction Cable (2017)		31	6	0.02	49	78	6	0.06
Goshawk PFA Fuels Reduction Cable (2033)		32	7	0.02	53	69	6	0.07
Goshawk Nest Fuels Reduction (2017)	100	23	5	0.03	54	177	5	0.05
Goshawk Nest Fuels Reduction (2033)		4	7	0.03	57	169	9	0.09
Schultz Nest - Hand Thin (2017)	122	11	22	0.07	52	210	10	0.17
Schultz Nest - Hand Thin (2033)		11	27	0.08	60	199	18	0.18
MSO Nest Roost Recovery – Hand Thin (2017)	72	21	14	0.06	54	97	7	0.17
MSO Nest Roost Recovery – Hand Thin (2033)		22	18	0.07	57	92	20	0.17
Mixed Conifer Fuels Reduction GB (2017)	1140	29	13	0.04	49	240	7	0.12
Mixed Conifer Fuels Reduction GB (2033)		9	16	0.04	53	232	15	0.14
Mixed Conifer Fuels Reduction Cable (2017)		21	21	0.04	49	308	9	0.13
Mixed Conifer Fuels Reduction Cable (2033)		5	18	0.05	53	297	19	0.14
Ponderosa Pine Fuels Reduction GB (2017)	1865	24	5	0.02	38	148	6	0.07
Ponderosa Pine Fuels Reduction GB (2033)		28	7	0.03	44	141	6	0.07
Ponderosa Pine Fuels Reduction Cable (2017)		27	6	0.02	40	93	7	0.07
Ponderosa Pine Fuels Reduction Cable (2033)		24	7	0.02	44	86	7	0.07
No Treatment	1605	-	-	-	-	-	-	-
** Not modeled due to limited stand data								

Table 42: Mormon Mountain average for Alternative 2 projected post-treatment conditions.

Alt. 2 Projected Conditions Mormon Mountain Post-Treatment 2017 Post-Treatment 2033	Acreage	Canopy Base Height (ft.)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Potential Flame Length (ft.) *Desired (4-8 ft.)*	Potential Smoke Emission (PM2.5) (lbs/tons consumed)
Electronic Site - Structure Protection	12	**Not Modeled						
MSO Nest Mixed Conifer-Burn Only	402	11	8	0.04	48	243	16	0.24
MSO Nest Mixed Conifer-Burn Only		12	24	0.05	53	227	19	0.27
MSO Nest Ponderosa Pine -Burn Only		11	8	0.04	48	243	16	0.16
MSO Nest Ponderosa Pine-Burn Only		12	24	0.05	53	227	19	0.18
MSO Nest / Roost Recovery (2017)	22	30	8.8	0.03	55	241	6	0.10
MSO Nest / Roost Recovery (2033)		30	15	0.04	61	235	6	0.14
MSO PAC MC Fuels Reduction Cable (2017)	1592	20	22	0.09	58	504	22	0.25
MSO PAC MC Fuels Reduction Cable (2033)		17	25	0.08	62	483	36	0.26
MSO PAC MC Fuels Reduction Ground Based (2017)		14	15	0.07	45	438	18	0.20
MSO PAC MC Fuels Reduction Ground Based (2033)		12	21	0.08	51	421	30	0.22
MSO PAC PP Fuels Reduction Cable (2017)		27	7	0.025	35	182	9	0.08

MSO PAC PP Fuels Reduction Cable (2033)		25	12	0.03	41	175	9	0.09
MSO PAC PP Fuels Reduction Ground Based(2017)		32	7	0.02	43	196	8	0.09
MSO PAC PP Fuels Reduction Ground Based (2033)		31	12	0.02	48	189	7	0.11
MSO PAC Fuels Reduction - Wet MC (2017)	180	9	28	0.10	60	382	33	0.38
MSO PAC Fuels Reduction - Wet MC (2033)		9	37	0.11	60	368	46	0.39
Ponderosa Pine Fuels Reduction Pine/Oak (2017)	766	30	7	0.01	42	240	5	0.08
Ponderosa Pine Fuels Reduction Pine/Oak (2033)		28	10	0.02	49	230	5	0.09
** Not modeled due to limited stand data								

Thinning and introducing prescribed fire in the project area would lower the potential for uncontrollable wildfire that would produce undesirable and perhaps detrimental effects to the ecosystem, especially in areas where fire hazard ratings are *extreme* to *high* and fire regime and condition classes are outside the natural range of variability.

Fire hazard ratings were calculated for existing and desired conditions for 50 percent (3,835 acres) of the DLH and 93 percent (2,784 acres) in the MM areas, commensurate with the area in which field data was collected in each portion of the total project area.

The DLH fire hazard ratings after modeling implementation of Alternatives 2 and 3 are illustrated in Table 43.

Table 43: Dry Lake Hills Fire Hazard post treatment Alts 2 & 3

Existing Fire Hazard	Acres	Percent	**Post Treatment Fire Hazard**	Acres	Percent
Extreme	2,582	67%	Extreme	91	2%
Very High	72	4%	Very High	268	8%
High	613	15%	High	510	13%
Moderate	470	12%	Moderate	1,930	50%
Low	100	2%	Low	1,036	27%

MM fire hazard ratings after modeling implementation of Alternatives 2 and 3 are illustrated in Table 44.

Table 44 Mormon Mountain Fire hazard post treatment Alts 2 & 3

Existing Fire Hazard	Acres	Percent	**Post Treatment Fire Hazard**	Acres	Percent
Extreme	2089	75%	Extreme	526	18%
Very High	197	8%	Very High	10	1%
High	273	10%	High	273	9%
Moderate	173	6%	Moderate	736	26%
Low	51	1%	Low	1,284	46%

Differences between 97th percentile conditions and Schultz are negligible, therefore only post treatment conditions under Schultz are listed. Modeling fire hazard after treatments within the project areas shows decreases in fire hazard, as Table 43 and Table 44 illustrate. However *extreme* and *very high* ratings are still present in both scenarios. This is because the stands are mixed conifer cover types and modeling did not show a drastic decrease in surface fuel loading. These stands have dead and down fuel loading of over 45 tons per acre and are on slopes greater than 30 percent.

Alternative 2 proposes to thin and prescribe burn 570 acres in the DLH area that are currently rated as *moderate* or *low* fire hazard. Within the MM area there are also 173 acres that are currently rated as *moderate* and 51 acres rated as *low*. Although these acres already have an acceptable fire hazard rating, proposed treatments would further improve stand composition, conditions, and structure that can lead to extreme fire behavior. Without the proposed thinning and burning, both current and future stand conditions would most likely promote extreme fire behavior within the urban interface if a fire occurred within and surrounding areas of the project area.

The following table is a comparison of the arrival times for post treatment conditions.

Table 45: Comparison Arrival time in acres/hour Alternative 2 & 3

Arrival Time	Intersection of FR 420 and 557 (the Y)		Intersection of 557rd and Oldham Trail		Paradise		Mormon Mountain 648 Rd	
	Existing Conditions	Post-Treatment Conditions	Existing Conditions	Post-Treatment Conditions	Existing Conditions	Post-Treatment Conditions	Existing Conditions	Post-Treatment Conditions
1st HR	51	1	469	23	259	91	197	1
2nd HR	318	12	1411	45	1217	324	607	4
3rd HR	960	25	2414	244	2012	584	1103	8
4th HR	1604	70	3482	484	2773	971	1614	22
5th HR	2803	192	4156	704	3438	1398	2508	81

Arrival time and ignition locations are identified in the maps displayed under the alternative analyses below.

The fire regime for the majority of the project would remain the same (fire regime 1) an open forest maintained by frequent low severity fires. The remaining portions of the project area are fire regime II characterized by a fire frequency between 0 and 35 years, but with a high severity (more than 75 percent of the dominant overstory replaced) and fire regime III a mosaic of open forest to mid-seral maintained by mixed severity fires recurring generally 35 to 100 years. Over the course of the 20 years analyzed, the vegetation condition classes would be greatly improved, where vegetation composition, structure, and fuels are similar to those of the natural regime and do not predispose the system to risk of loss of key ecosystem components. A wildfire occurring under post-treatment conditions would be characteristic of the historic fire regime behavior, severity, and patterns.

Cumulative Effects

The area analyzed for the cumulative fire effects of this project is the Flagstaff Ranger District, as this encompasses most of the forested land subject to the prevailing winds driving a wildfire into the community of Flagstaff and the surrounding areas. The project areas (DLH and MM) are within the Flagstaff Community Wildfire Protection Plan area (CWPP) the treatments proposed are in line with the goals and objectives set forth by the CWPP.

The time period analyzed for the cumulative fire effects of this project includes a twenty year period from 2013 to 2033. Prior to that time the only activities in the area that affected the fire hazard were aggressive fire suppression and the continuing growth of forest vegetation.

The effects of FWPP would cumulatively combine with other previously-analyzed forest health and fuel reduction projects that lie in the path of the prevailing winds around Flagstaff and its suburbs (Wing Mtn., Hart Prairie, Eastside, Ft. Valley Restoration, A-1 Multi-Product, Mars Hill, Ritter, Sinks, Mormon Lake Basin, Woody Ridge, Kachina Village, Lake Mary Fuel Reduction, Mountainaire, Elk Park, Jack Smith Schultz, Eastside, Marshall and Skunk Fuel Reduction) to reduce the potential for high severity fire impacting the City of Flagstaff. The treatments within these projects do not eliminate the chance of a crown fire, but greatly reduce the chance of a crown fire initiating within their bounds and spreading to adjacent lands.

The Flagstaff District is currently conducting analysis for the Turkey Butte - Barney Pasture Forest Health and Fuels Reduction Project, located approximately thirty miles south of the Flagstaff area. However, this project would not have a cumulative effect on the fire behavior or fire hazard of the FWPP area due to the distance between the two project areas.

By treating the Flagstaff Watershed Protection area, the potential of a crown fire starting in the project areas and spreading as a crown fire through adjacent areas would be reduced. This treatment would further reduce the potential of crown fire spreading to nearby urban interface areas at risk and improve this fire adapted ecosystem.

The Four Forests Restoration Initiative (4FRI) is currently being assessed through the NEPA process. The preferred alternative includes 434,001 acres of mechanical vegetation treatments and 593,211 acres of prescribed burning, and encompasses a large portion of the Flagstaff Ranger District, including most of the acres adjacent to MM, and many areas adjacent to DLH. The implementation of the 4FRI acres covered in the FEIS is expected to begin in late 2014 or 2015. The 4FRI will have significant impact on hazardous fuel loading and fire hazard on the Flagstaff District. The cumulative effects, when combined with FWPP, should greatly reduce the likelihood of high-intensity crown fire from entering the project area from the surrounding landscape over the next ten years. Both the DLH and the MM areas overlap with 4FRI treatments, and implementation should occur simultaneously, thus in the short-term (one to two years in treatment areas) these overlapping or adjacent treatments could result in an increase in activity fuels, which could increase the likelihood of passive crown fires occurring.

The effects of past treatments and wildfires within the area considered for cumulative effects could affect if and how wildfires burn into the treatment area. Vegetation/fuels in treated/burned areas are more likely to produce surface fires, which are easier to manage and are likely to produce effects that are beneficial to the ecosystems. Since existing conditions and proposed treatments vary widely across the projects discussed, and even within individual projects, it is difficult to summarize the fire effects. It is accurate to state that the combination of treatments would have the effect of cumulatively reducing the potential for active crown fires over the next 20 years and thus reduce fire-induced tree mortality across all size classes.

The effects of climate change would also have an effect on the potential of high severity wildfire. Several studies have concluded that the expected changes in climate will likely result in more burned area from wildfires than in the past (Litschert et al. 2012, Marlon et al. 2009), and that there will be more wildfires of much greater severity, especially in the spring and early summer (Westerling et al. 2006). According to Millar et al., resilient forests are “those that not only accommodate gradual changes related to climate but tend to return toward a prior condition after disturbance either naturally or with management assistance (2007). Prescribed burning has been identified as an important management strategy for maintaining desired habitats in a changing climate with more natural disturbances (USDA FS 2010, Williams 2013). The cumulative effects of FWPP and other similar fuels reduction/forest health restoration projects on the Flagstaff Ranger District would be to increase the resiliency of the forest to the effects of climate change.

It is also accurate to state that wildfires occurring in these treated areas would be easier to control and burn less severely with less acreage burned than if the areas were left untreated. These projects combine to form a defensible space for Flagstaff and its surrounding communities.

Unavoidable Adverse Effects, Irreversible and Irretrievable Commitment of Resources

There would not be any irreversible or irretrievable commitments of resources from the reduction of wildfire hazard and fuels reduction treatments.

Alternative 3: Proposed Action without Cable Logging

Direct and Indirect Effects

In general, effects to fuel and fire resources under Alternative 3 would be the same as those described in Alternative 2, with minor differences in acreages due to harvesting methods (see Direct and Indirect Effects Common to Alternatives 2 and 3). These minor differences affect predicted prescribed fire outcomes evident as slight increases in flame length, mortality, scorch height and downed woody debris, primarily in the mixed conifer vegetation type on steep slopes.

Slight differences in prescribed fire effects (flame length, scorch height, mortality and downed woody debris) are also evident between Alternative 2 and 3. Alternative 3 could leave more material on the ground compared to Alternative 2 because of harvesting methods and the lack of cable corridors.

Table 46: Prescribed Fire Implementation Effects Dry Lake Hills Alternative 3

Alt.3 Prescribed Fire Implementation Effects by Treatment	Flame Length (ft)	Scorch Height (ft)	Smoke Emission (PM2.5) (tons	Mortality (BA Killed)	Post Burn DWD 12+ (tons/acre)
Electronic Site – Structure Protection	**Not Modeled				
Grassland Restoration	**Not Modeled				
Ponderosa Pine Fuels Reduction - Hand Thin	**Not Modeled				
Aspen Treatment - Hand Thin	**Not Modeled				
Mixed Conifer - Hand Thin	3.8	22.8	0.14	10.4	7.8
MSO PAC - Hand Thin	3.7	22.1	0.1	4	14.9
Burn Only	4.9	30.6	0.08	19.4	2.7
Nest Core Burn Only	4.2	25.9	0.04	7.4	0.4*
Goshawk PFA MC Fuels Reduction (Ground Based)	4	24.1	0.07	4.5	2.9
MSO PAC Fuels Reduction GB	2.6	12.5	0.09	4.4	7.8
MSO PAC Fuels Reduction (Helicopter)	2.6	12.5	0.1	3.2	10.8
MSO PAC Fuels Reduction (Steep Slope Equipment)	2.6	12.6	0.09	3.7	6.8
Goshawk PFA PP Fuels Reduction (Ground Based)	3.3	16.3	0.06	3.1	0.3*
Goshawk PFA PP Fuels Reduction Heli	3.2	15.8	0.08	4.7	1.1
Goshawk Nest Fuels Reduction 70BA	2.6	11.1	0.07	3.6	1.1

Alt.3 Prescribed Fire Implementation Effects by Treatment	Flame Length (ft)	Scorch Height (ft)	Smoke Emission (PM2.5) (tons	Mortality (BA Killed)	Post Burn DWD 12+ (tons/acre)
Schultz Nest - Hand Thin	3.6	21.1	0.1	15.8	15.8
Mixed Conifer Fuels Reduction (Ground Based)	4.1	24.5	0.12	4.8	8
Mixed Conifer Fuels Reduction (Helicopter)	4.2	25.6	0.12	4.6	8.8
Mixed Conifer Fuels Reduction (Steep Slope Equipment)	4.3	26.1	0.11	4.7	5.8
Ponderosa Pine Fuels Reduction (Ground Based)	3.1	13.9	0.08	5	0.6*
Ponderosa Pine Fuels Reduction (Helicopter)	3.6	18.3	0.08	3.8	1.3
* Pretreatment values were less than 1 ton/acre for downed woody debris larger than 12", ** Not modeled due to limited stand data					

Table 47: Prescribed Fire Implementation Effects Mormon Mountain Alternative 3

Alt.3 Prescribed Fire Implementation Effects by Treatment	Flame Length (ft)	Scorch Height (ft)	Smoke Emission (PM2.5) (tons	Mortality (BA Killed)	Post Burn DWD 12+ (tons/acre)
Electronic Site - Structure Protection	**Not Modeled				
MSO Nest Mixed Conifer-Burn Only	1.8	7	0.18	9.1	7.1
MSO Nest Ponderosa Pine -Burn Only	2.2	10.2	0.09	11.6	0.3*
MSO Nest / Roost Recovery	3.7	21.5	0.11	11.7	1.0*
MSO PAC MC Fuels Reduction (Ground Based)	2.1	8	0.16	7.6	7.8
MSO PAC PP Fuels Reduction (Ground Based)	2.9	14.2	0.1	3.8	0.8*
MSO PAC Fuels Reduction - Wet MC	4.5	24.8	0.24	33.9	14
Ponderosa Pine Fuels Reduction Pine/Oak	2.3	8.9	0.1	6.9	0.3*
* Pretreatment values were less than 1 ton/acre for downed woody debris larger than 12", ** Not modeled due to limited stand data					

Table 48 and Table 49 represent post mechanical treatments and modeled wildfire conditions if a fire were to start and burn through the project areas under Schultz fire conditions.

Table 48: Dry Lake Hills average projected treatment conditions for Alternative 3.

Alt. 3 Projected Conditions Dry Lake Hills *(Desired Conditions)* Post-Treatment 2017 / Post-Treatment 2033	Acreage	Canopy Base Height (ft.)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Potential Flame Length (ft.) *Desired (4-8 ft.)*	Potential Smoke Emission (PM2.5) (lbs/tons consumed)
Electronic Site – Structure Protection	6	**Not Modeled						
Grassland Restoration	60	**Not Modeled						
Ponderosa Pine Fuels Reduction - Hand Thin	150	**Not Modeled						
Aspen Treatment - Hand Thin (2017)	22	**Not Modeled						
Mixed Conifer - Hand Thin (2017)	85	23	15	0.05	50	112	7	0.17
Mixed Conifer - Hand Thin (2033)		23	19	0.06	55	107	7	0.17
MSO PAC - Hand Thin (2017)	202	22	20	0.04	55	82	6	0.12
MSO PAC - Hand Thin (2033)		23	23	0.04	56	75	6	0.14
Burn Only (2017)	270	19	10	0.5	53	140	15	0.13
Burn Only (2033)		24	17	0.55	57	129	16	0.15
Nest Core Burn Only (2017)	261	23	4	0.05	52	114	8	0.08
Nest Core Burn Only (2033)		28	10	0.05	53	102	8	0.10
MSO PAC Fuels Reduction (Ground Based) (2017)	1195	23	13	0.04	54	307	7	0.11
MSO PAC Fuels Reduction (Ground Based) (2033)		13	17	0.05	58	297	14	0.13
MSO PAC Fuels Reduction Heli (2017)		19	16	0.04	55	269	5	0.12
MSO PAC Fuels Reduction Heli (2033)		5	17	0.04	58	260	12	0.14
MSO PAC Fuels Reduction (Steep Slope) (2017)		25	13	0.04	56	185	5	0.10
MSO PAC Fuels Reduction (Steep Slope)(2033)		12	17	0.04	60	375	10	0.13
Goshawk PFA PP Fuels Reduction (Ground Based) (2017)	359	29	4	0.02	49	106	4	0.05

Goshawk PFA PP Fuels Reduction (Ground Based) (2033)		25	7	0.02	52	99	4	0.07
Goshawk PFA PP Fuels Reduction Heli (2017)		30	6	0.02	45	79	6	0.07
Goshawk PFA PP Fuels Reduction Heli (2033)		31	7	0.02	50	70	6	0.07
Goshawk PFA MC Fuels Reduction GB (2017)		24	7	0.04	50	200	7	0.14
Goshawk PFA MC Fuels Reduction GB (2033)		2	11	0.04	55	192	21	0.11
Goshawk Nest Fuels Reduction 70BA (2017)	100	23	5	0.03	50	177	5	0.05
Goshawk Nest Fuels Reduction 70BA (2033)		4	7	0.03	55	169	9	0.09
Schultz Nest - Hand Thin (2017)	122	11	22	0.07	52	210	10	0.17
Schultz Nest - Hand Thin (2033)		11	27	0.08	60	199	18	0.18
MSO Nest Roost Recovery – Hand Thin (2017)	72	21	14	0.06	54	97	7	0.17
MSO Nest Roost Recovery – Hand Thin (2033)		22	18	0.07	57	92	20	0.17
Mixed Conifer Fuels Reduction (Ground Based) (2017)	1158	29	13	0.4	49	240	7	0.12
Mixed Conifer Fuels Reduction (Ground Based) (2033)		9	16	0.04	53	232	15	0.14
Mixed Conifer Fuels Reduction Heli (2017)		21	21	0.04	41	308	9	0.13
Mixed Conifer Fuels Reduction Heli (2033)		5	18	0.05	45	297	19	0.13
Mixed Conifer Fuels Reduction (Steep Slope)(2017)		33	11	0.02	45	375	8	0.17
Mixed Conifer Fuels Reduction (Steep Slope)(2033)		1	14	0.03	50	365	16	0.13
Ponderosa Pine Fuels Reduction (Ground Based) (2017)	1865	24	5	0.02	38	148	6	0.07
Ponderosa Pine Fuels Reduction (Ground Based) (2033)		28	7	0.03	44	141	6	0.07
Ponderosa Pine Fuels Reduction Heli (2017)		26	6	0.02	40	86	7	0.06
Ponderosa Pine Fuels Reduction Heli (2033)		26	7	0.02	43	79	7	0.07
No Treatment	1605							
** Not modeled due to limited stand data								

Table 49: Mormon Mountain average projected treatment conditions for Alternative 3.

Alt. 3 Projected Conditions Mormon Mountain (Desired Conditions)	Acreage	Canopy Base Height (ft.)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Potential Flame Length (ft.) Desired (4-8 ft.)	Potential Smoke Emission (PM2.5) (lbs/tons consumed)
Post-Treatment 2017								
Post-Treatment 2033								
Electronic Site - Structure Protection	12	**Post Treatment Conditions Not Modeled						
MSO Nest Mixed Conifer-Burn Only	402	11	8	0.04	48	243	16	0.24
MSO Nest Mixed Conifer-Burn Only		12	24	0.05	53	227	19	0.27
MSO Nest Ponderosa Pine -Burn Only		11	8	0.04	48	243	16	0.16
MSO Nest Ponderosa Pine-Burn Only		12	24	0.05	53	227	19	0.18
MSO Nest / Roost Recovery (2017)	22	30	8.8	0.03	55	241	6	0.10
MSO Nest / Roost Recovery (2033)		30	15	0.04	61	235	6	0.14
MSO PAC MC Fuels Reduction (Ground Based) (2017)	1592	14	15	0.07	58	438	18	0.20
MSO PAC MC Fuels Reduction (Ground Based) (2033)		12	21	0.08	62	421	30	0.22

MSO PAC PP Fuels Reduction Ground Based(2017)		32	7	0.02	35	196	8	0.09
MSO PAC PP Fuels Reduction Ground Based (2033)		31	12	0.02	41	189	7	0.11
MSO PAC Fuels Reduction - Wet MC (2017)	180	9	28	0.10	60	382	33	0.38
MSO PAC Fuels Reduction - Wet MC (2033)		9	37	0.11	60	368	46	0.39
Ponderosa Pine Fuels Reduction Pine/Oak (2017)	766	30	7	0.01	42	240	5	0.08
Ponderosa Pine Fuels Reduction Pine/Oak (2033)		28	10	0.02	49	230	5	0.09
** Not modeled due to limited stand data								

Cumulative Effects

Cumulative effects from Alternative 3 are the same as those discussed under Alternative 2.

Unavoidable Adverse Effects, Irreversible and Irretrievable Commitment of Resources

Unavoidable Adverse Effects, Irreversible and Irretrievable Commitment of Resources would be identical to those discussed for Alternative 2.

Alternative 4 – Minimal Treatment Approach

The purpose of Alternative 4 is to implement the minimum amount of treatment necessary to meet the purpose and need. Therefore the effects would occur to a lesser degree (e.g. on fewer acres and with less intensity). Alternative 4 would treat 2,504 fewer acres in the DLH and 632 fewer acres on MM than under Alternatives 2 and 3.

Treatments are proposed for those areas with dense fuel loading where topography aligns with dominant winds and the probability of severe effects to soil resources from a wildfire is greater, based on FLAM MAP 5.0 modeling of both fire behavior and fire spread under Schultz fire weather conditions. Specifically, factors considered include: fire risk rating, potential damage to soils (from high severity fire and also harvesting methods), MSO habitat, and the type of harvesting methods necessary to affect change.

Under Alternative 4, 3,459 acres along the base of Dry Lake Hills and Mount Elden and the upper, flatter tops would receive basically the same treatments proposed in Alternatives 2 and 3, though under this alternative more areas are proposed for hand thinning and prescribed burning instead of cable or helicopter logging in order to reduce the potential impacts from temporary road network associated with those harvesting methods. Additionally, treatments are focused on the area south and east of FR420; the portion of the project area between FR420 and the Kachina Peaks Wilderness would still be treated but under the constraints of the analysis and decision for the Jack Smith Schultz Fuels Reduction and Forest Health Restoration Project. Thus, no new analysis would be performed for those areas under this alternative.

The Spruce Avenue Wash was identified as a high priority area due to the fuel loading, topography, size and also its location relative to the City of Flagstaff and MSO PACs. The portion of the Elden MSO PAC within the Spruce Avenue Wash would also be treated under the same parameters described in Alternatives 2 and 3.The Schultz MSO PAC and nest core were identified in conjunction with the FWS as high priority areas, and would also receive the same treatment described for Alternatives 2 and 3.

For Mormon Mountain, treatments would occur on 2,343 acres. The same methodology used for treatment placements in the Dry Lake Hills area was applied to Mormon Mountain to determine where to focus treatments. Under Alternative 4, the wet mixed conifer belt and MSO nest cores would not be treated; however treatments would occur below and above that belt.

Areas not included in this alternative would be designated as No Treatment. All treated acres would include prescribed burning in the manner described under Alternative 2 and 3: initially pile burning to remove slash accumulated through harvesting, followed by broadcast burning. Maintenance burning may occur every five to seven years following implementation in order to maintain lower fuel loading levels and to restore a frequent, low-severity fire regime. Mixed conifer may only receive one broadcast burn through the life of the project due to the historic Fire Return Interval in some vegetation types is historically longer than the life of this project. Other slash removal options as described in the Implementation Methods section could also be used in lieu of burning, including biomass removal.

Direct and Indirect Effects

Ground Fuels and Vegetation

Direct effects of Alternative 4 would be consistent with other similar fuels treatment projects on the Flagstaff Ranger District: prescribed fire would reduce surface fuels, raise crown base heights, reduce stems per acre and improve stand conditions. Prescribed fire may also result in an increase in mortality and reduce the amount of available logs and snags (Table 50 and Table 51), consistent with the other two action alternatives, but on fewer acres.

Table 50: Prescribed Fire Implementation Effects Dry Lake Hills Alternative 4.

Alt.4 Prescribed Fire Implementation Effects by Treatment	Flame Length (ft)	Scorch Height (ft)	Smoke Emission (PM2.5) (tons	Mortality (BA Killed)	Post Burn DWD 12+ (tons/acre)
Aspen Treatment - Hand Thin	**Not Modeled				
Electronic Site Structure Protection	**Not Modeled				
Goshawk Nest Fuels Reduction	2.6	11.1	0.07	3.6	1.1
Goshawk PFA MC Fuels Reduction (Ground Based)	4	24.1	0.07	4.5	2.9
Goshawk PFA PP Fuels Reduction (Ground Based)	3.2	15	0.07	3.4	0.4*
MSO Nest Fuels Reduction - Hand Thin	3.2	15.8	0.07	3.4	0.4*
MSO PAC MC Fuels Reduction (Ground Based)	2.6	12.6	0.1	3.3	10.5
MSO PAC PP Fuels Reduction (Ground Based)	2.7	13.3	0.6	3.9	0.4*
MSO PAC Fuels Reduction - Hand Thin	3.7	22.1	0.1	4	14.9
Mixed Conifer Fuels Reduction (Ground Based)	4.1	24.5	0.12	4.8	8
Ponderosa Pine Fuels Reduction (Ground Based)	3.1	14	0.08	5.6	0.2*

* Pretreatment values were less than 1 ton/acre for downed woody debris larger than 12", ** Not modeled due to limited stand data

Table 51 Prescribed Fire Implementation Effects Mormon Mountain Alternative 4.

Alt.4 Prescribed Fire Implementation Effects by Treatment	Flame Length (ft)	Scorch Height (ft)	Smoke Emission (PM2.5) (tons	Mortality (BA Killed)	Post Burn DWD 12+ (tons/acre)
Electronic Site - Structure Protection	**Not Modeled				
MSO Nest Mixed Conifer-Burn Only	1.8	7	0.18	9.1	7.1
MSO Nest Ponderosa Pine -Burn Only	2.2	10.2	0.09	11.6	0.3*
MSO Nest / Roost Recovery	3.7	21.5	0.11	11.7	1.0*
MSO PAC MC Fuels Reduction (Ground Based)	2.1	8	0.16	7.6	7.8
MSO PAC PP Fuels Reduction (Ground Based)	2.9	14.2	0.1	3.8	0.8*
MSO PAC Fuels Reduction - Wet MC	4.5	24.8	0.24	33.9	14
Ponderosa Pine Fuels Reduction Pine/Oak	2.3	8.9	0.1	6.9	0.3*

* Pretreatment values were less than 1 ton/acre for downed woody debris larger than 12", ** Not modeled due to limited stand data

Fire Suppression Efforts

Under Alternative 4, approximately 3,136 acres would not be treated in the project area, resulting in a lesser probability of containing a wildfire during an operational period if a fire were to start in the untreated areas. Fire suppression would likely have to focus containment efforts on the base of the slopes and ridge tops to be most effective.

Figure 48: Estimated Fire Progression for Alternative 4, DLH

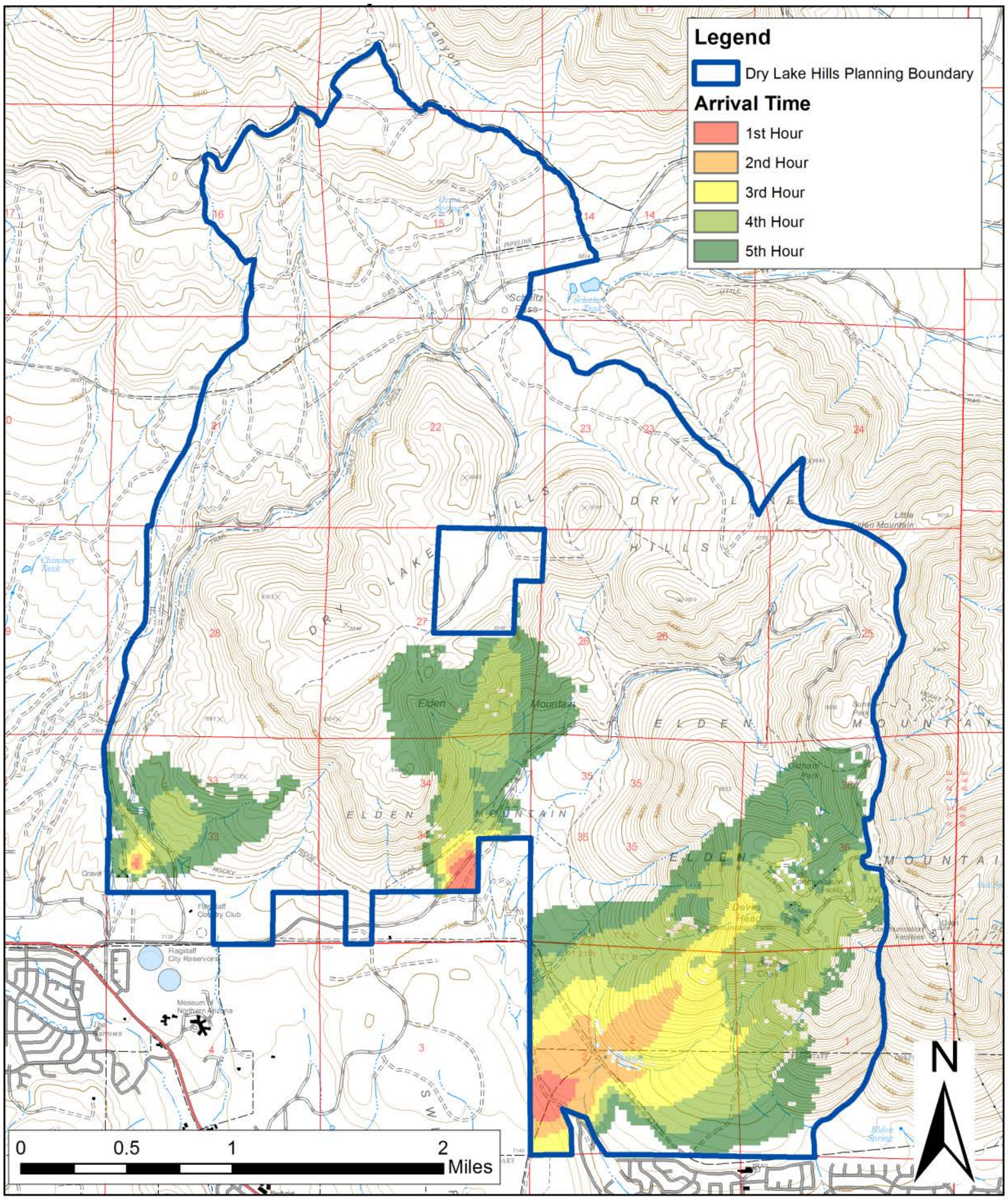
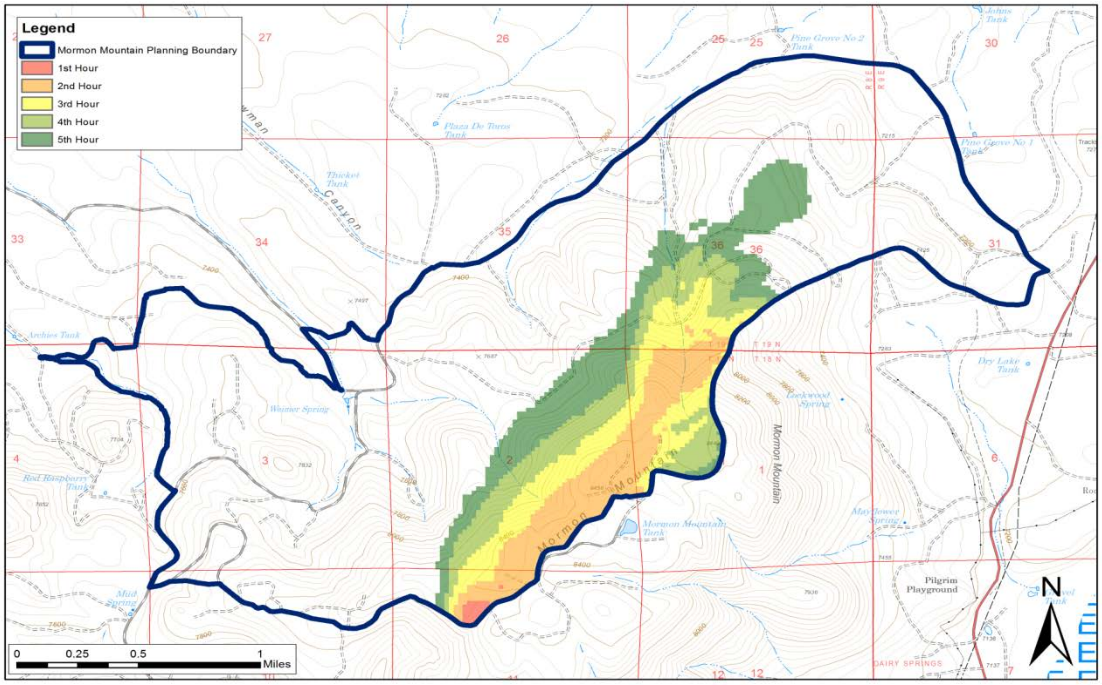


Figure 49: Estimated Fire Progression for Alternative 4, MM



Wildfire Hazard Potential

The direct and indirect effects would be similar in nature to Alternatives 2 and 3, with the exception that treatments are on a smaller scale and the project area at large could still have areas that are susceptible to high severity fires. Treatments in Alternative 4 would mitigate some potential for large scale fires; however since the entire area would not be treated, the project areas could be adversely affected by fires starting in neighboring stands and spreading through the Alternative 4 project boundary. Additionally a direct effect of a wildfire occurring outside of the Alternative 4 treatment areas could have adverse impacts to neighborhoods and communities that lie in the immediate areas surrounding the two project areas.

Alternative 4 would also include the permanent campfire closure order for the DLH portion, temporary area closures during implementation, and approximately 4 miles of decommissioned Forest Roads, which would result in a decrease in campfires and unauthorized motorized public access, thereby reducing the threat of human-caused fires within the DLH.

Alternative 4 would address the purpose and need by reducing the crown bulk density (thinning), reducing the canopy closure (thinning), increasing the effective crown base height in most sites (thinning and prescribed burning over time), and reducing the number of potential firebrands and shortening the distance at which spot fires would be expected to occur (thinning and prescribed burning), but to a lesser degree than Alternatives 2 and 3. Crown fire potential would be reduced under this alternative, but only on those acres treated. The 3,136 acres left untreated would retain the same crown fire potential as under the No Action Alternative**.**

Differences between 97th percentile conditions and Schultz are negligible, therefore only post treatment conditions under Schultz are listed. Crown fire potential for DLH modeled under Schultz conditions shows active crown fire on 2,326 acres, passive crown fire on 336 and 4,757 acres of surface fire (Figure 50, Table 52). Crown fire potential for MM modeled under Schultz conditions shows active crown fire on 558 acres, passive crown fire on 240 and 2,167 acres of surface fire.

Figure 50: Modeled Crown Fire potential for Alternative 4

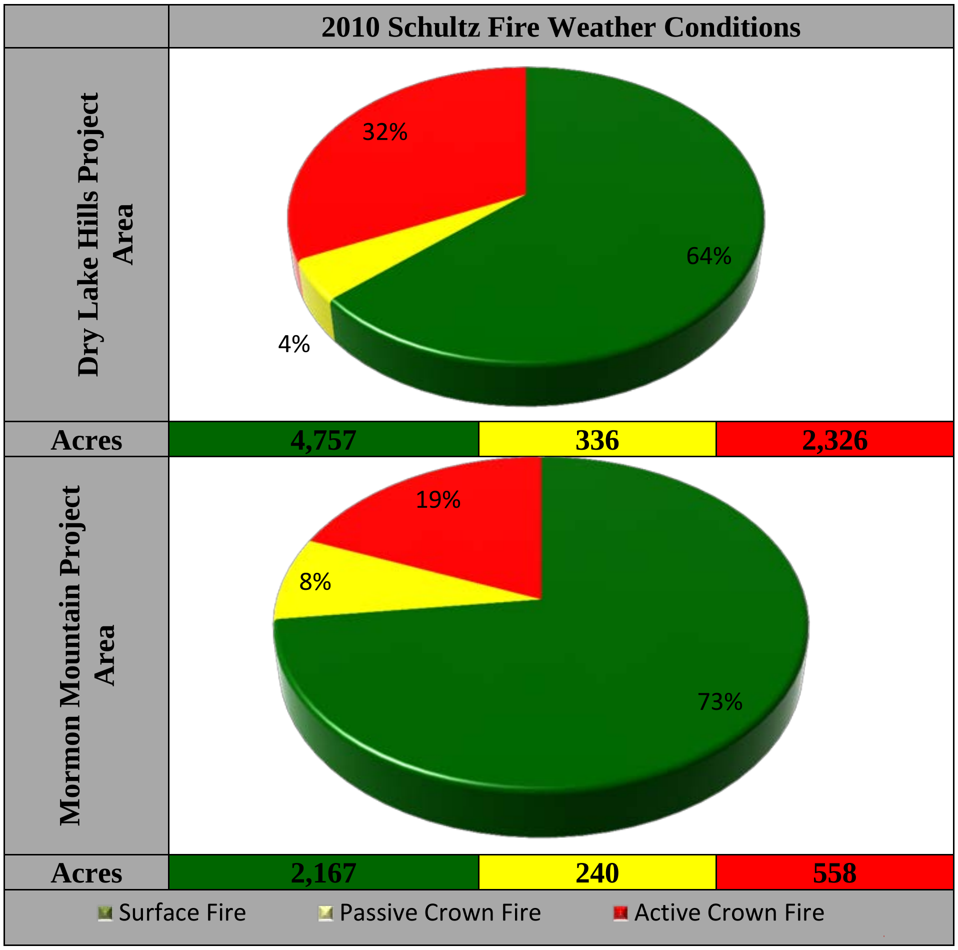


Table 52: Existing Crown fire potential and modeled Alt. 4

Dry Lake Hills	**Existing Crown Fire Potential (97th %)**	**Existing Crown Fire Potential Schultz**	**Alternative 4, Schultz conditions**
Active	5,480 acres	3,832 acres	2,326 acres
Passive	557 acres	749 acres	336 acres
Surface	1,426 acres	2,881acres	4,757 acres
Mormon Mountain	**Existing Crown Fire Potential (97th**	**Existing Crown Fire Potential**	**Alternative 4, Schultz conditions**

Dry Lake Hills	Existing Crown Fire Potential (97th %)	Existing Crown Fire Potential Schultz	Alternative 4, Schultz conditions
	%)	Schultz	
Active	2,201 acres	2,068 acres	558 acres
Passive	481 acres	725 acres	240 acres
Surface	286 acres	176 acres	2,167 acres
*Differences between 97th percentile conditions and Schultz are negligible, therefore only post treatment conditions under Schultz are listed.			

Figure 51: Alternative 4 fire behavior modeled under 2010 Schultz Wildfire weather conditions – Dry Lake Hills

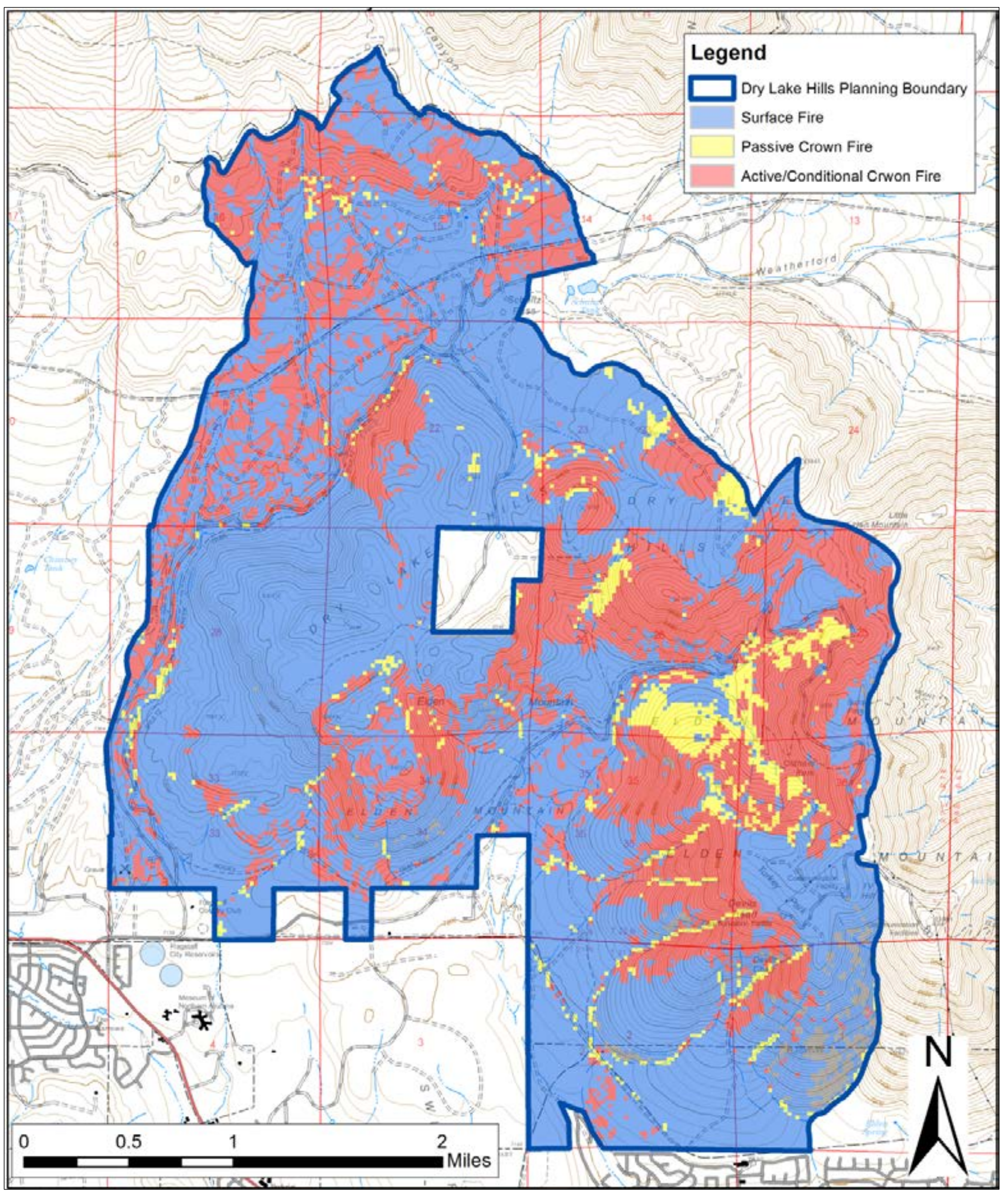
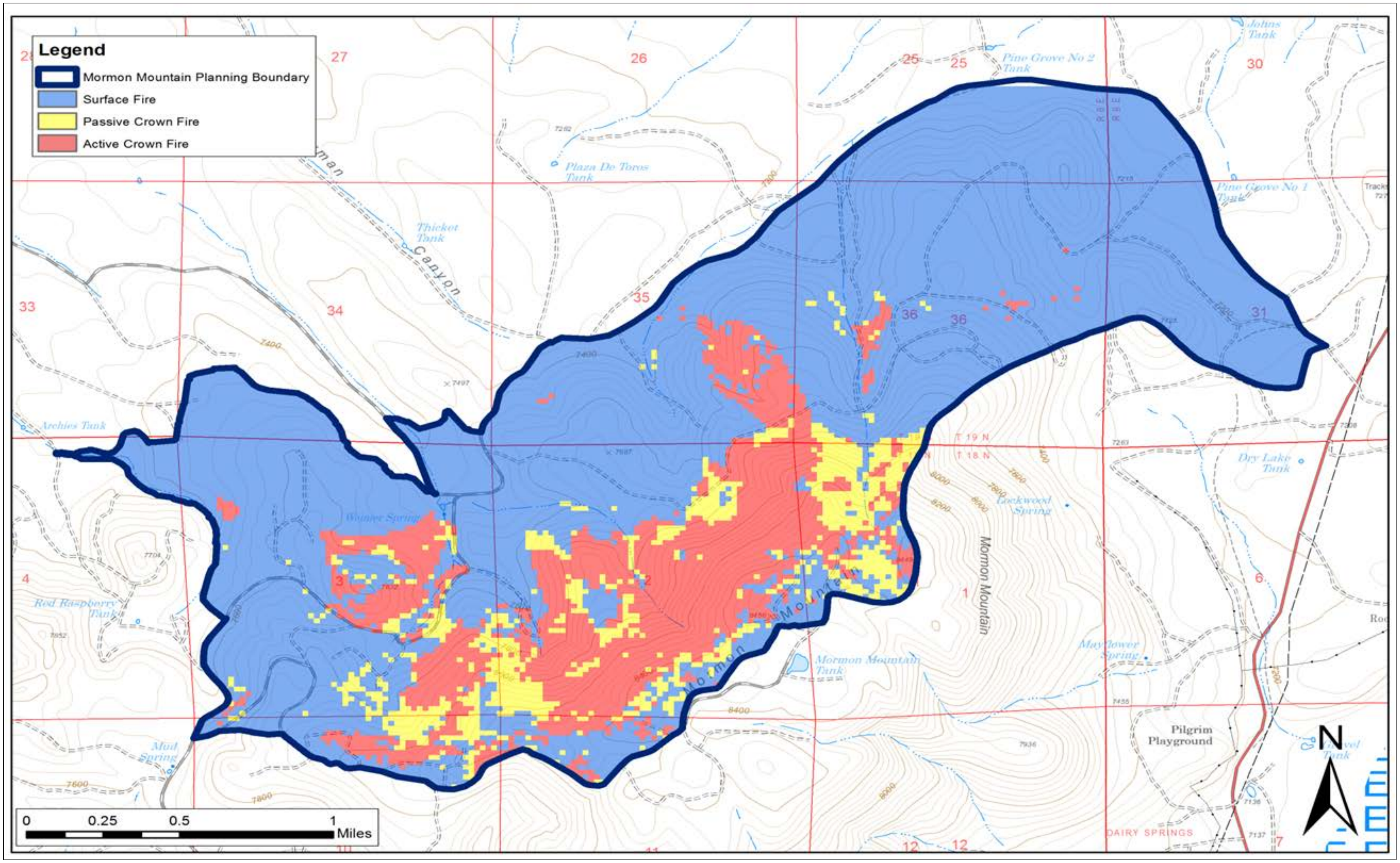


Figure 52: Alternative 4 fire behavior modeled under 2010 Schultz Wildfire weather conditions –Mormon Mountain



Implementation of Alternative 4 DLH modeled under Schultz conditions shows a reduction of crown fire potential from 3,832 to 2,326 acres of active crown fire, 749 to 336 acres of passive crown fire and 2,881to 4,757acres of surface fire behavior.

Within the MM area modeled under Schultz conditions shows a reduction of crown fire potential from 2,068 to 558 acres of active, 725 to 240 acres passive crown fire and 176 to 2,167 acres of surface fire behavior.

Table 53 and Table 54 represent post mechanical treatments and modeled wildfire conditions if a fire were to start and burn through the project areas under Schultz fire conditions.

Table 53: Dry Lake Hills average projected treatment conditions for Alternative 4

Alt. 4 Projected Conditions Dry Lake Hills (Desired Conditions) Post-Treatment 2017 Post-Treatment 2033	Acreage	Canopy Base Height (ft.)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Potential Flame Length (ft.) *Desired (4-8 ft.)*	Potential Smoke Emission (PM2.5) (lbs/tons consumed)
Aspen Treatment - Hand Thin (2017)	2	**Not Modeled						
Electronic Site Structure Protection	6	**Not Modeled						
Goshawk Nest Fuels Reduction (2017)	100	23	5	0.03	54	177	5	0.05
Goshawk Nest Fuels Reduction (2033)		4	7	0.03	57	169	9	0.09
Burn Only (2017)	67	19	10	0.5	53	140	15	0.13
Burn Only (2033)		24	17	0.55	57	129	16	0.15
Goshawk PFA MC Fuels Reduction (Ground Based)(2017)	286	24	7	0.04	50	200	7	0.14
Goshawk PFA MC Fuels Reduction (Ground Based)(2033)		2	11	0.04	55	192	21	0.11
Goshawk PFA PP Fuels Reduction (Ground Based)(2017)		27	5	0.03	49	93	4	0.06
Goshawk PFA PP Fuels Reduction (Ground Based)(2033)		21	8	0.03	52	87	4	0.08
MSO Nest Fuels Reduction - Hand Thin (2017)	122	11	22	0.07	54	210	10	0.17
MSO Nest Fuels Reduction - Hand Thin (2033)		11	27	0.08	57	199	18	0.18
MSO PAC MC Fuels Reduction (Ground Based)(2017)	568	19	16	0.04	50	434	5	0.12
MSO PAC MC Fuels Reduction (Ground Based)(2033)		4	19	0.04	55	422	15	0.15
MSO PAC PP Fuels Reduction (Ground Based)(2017)		23	5	0.04	49	153	5	0.05
MSO PAC PP Fuels Reduction (Ground Based)(2033)		18	9	0.04	52	144	8	0.09

MSO PAC Fuels Reduction - Hand Thin (2017)	228	22	20	0.04	54	82	6	0.12
MSO PAC Fuels Reduction - Hand Thin (2033)		23	23	0.04	60	75	6	0.14
Mixed Conifer Fuels Reduction (Ground Based)(2017)	542	29	13	0.4	49	240	7	0.12
Mixed Conifer Fuels Reduction (Ground Based)(2033)		9	16	0.04	53	232	15	0.14
Ponderosa Pine Fuels Reduction (Ground Based)(2017)	1400	28	5	0.02	38	111	6	0.07
Ponderosa Pine Fuels Reduction (Ground Based)(2033)		29	7	0.03	44	104	6	0.07
No Treatment	4110							
** Not modeled due to limited stand data								

Table 54: Mormon Mountain average projected treatment conditions for Alternative 4.

Alt. 4 Projected Conditions Mormon Mountain (Desired Conditions) / Post-Treatment 2017 / Post-Treatment 2033	Acreage	Canopy Base Height (ft.)	Dead and Downed Fuel (tons/acre) [avg]	Canopy Bulk Density (kg/M^3)	Canopy Closure (%)	Stems (Trees) per Acre	Potential Flame Length (ft.) Desired (4-8 ft.)	Potential Smoke Emission (PM2.5) (lbs/tons consumed)
Electronic Site - Structure Protection	12	**Not Modeled						
MSO Nest Mixed Conifer-Burn Only	33	11	8	0.04	48	243	16	0.24
MSO Nest Mixed Conifer-Burn Only		12	24	0.05	53	227	19	0.27
MSO Nest Ponderosa Pine -Burn Only		11	8	0.04	48	243	16	0.16
MSO Nest Ponderosa Pine-Burn Only		12	24	0.05	53	227	19	0.18
MSO Nest / Roost Recovery (2017)	22	30	8.8	0.03	55	241	6	0.10
MSO Nest / Roost Recovery (2033)		30	15	0.04	61	235	6	0.14
MSO PAC MC Fuels Reduction Ground Based (2017)	1509	14	15	0.07	45	438	18	0.20
MSO PAC MC Fuels Reduction Ground Based (2033)		12	21	0.08	51	421	30	0.22
MSO PAC PP Fuels Reduction Ground Based(2017)		32	7	0.02	43	196	8	0.09
MSO PAC PP Fuels Reduction Ground Based (2033)		31	12	0.02	48	189	7	0.11

MSO PAC Fuels Reduction - Wet MC (2017)		14	15	0.07	60	437	18	0.38
MSO PAC Fuels Reduction - Wet MC (2033)		12	21	0.08	60	421	30	0.39
Ponderosa Pine Fuels Reduction Pine/Oak (2017)	766	30	7	0.01	42	240	5	0.08
Ponderosa Pine Fuels Reduction Pine/Oak (2033)		28	10	0.02	49	230	5	0.09
No Treatment	631							
** Not modeled due to limited stand data								

The following table is a comparison of the arrival times for post treatment conditions.

Table 55: Comparison Arrival time in acres/hour Alternative 4

Arrival Time	Intersection of FR 420 and 557 (the Y)		Intersection of 557rd and Oldham Trail		Paradise		Mormon Mountain 648 Rd	
	Existing Conditions	Post-Treatment Conditions	Existing Conditions	Post-Treatment Conditions	Existing Conditions	Post-Treatment Conditions	Existing Conditions	Post-Treatment Conditions
1st HR	51	1	469	14	259	26	197	6
2nd HR	318	3	1,411	20	1,217	148	607	185
3rd HR	960	9	2,414	32	2,012	395	1,103	343
4th HR	1,604	64	3,482	170	2,773	882	1,614	504
5th HR	2,803	206	4,156	424	3,438	1,296	2,508	734

Arrival time acreages for DLH under Alternative 4 are smaller than Alternative 2 and 3 modeling due to the fact that Alternative 4 would not alter fuel model composition as extensively as Alternatives 2 and 3. Alternatives 2 and 3 have a higher component of Grass/Shrub fuel models that contribute to faster fire spread; whereas, the fire type is less severe than Alternative 4.

Cumulative Effects

Cumulative effects for Alternative 4 would be the same as Alternatives 2 and 3, except to a lesser degree.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

Amendment 1:

Effects of Forest Plan Amendment 1 would be the same impacts on fire, fuel and air resources as the direct and indirect effects discussed for the action alternatives. If the amendment did not occur: 1) Mechanical treatments would be limited to a maximum of 9 inches dbh in the PACs thereby restricting the treatment to a fuels reduction objective and reducing the ability to improve MSO habitat in terms of reducing overall stand densities to desired levels, creating groups, openings, increasing or maintaining age class and species diversity, and liberation of overtopped oak.; 2) Without the use of prescribed fire in MSO core areas, the opportunity to improve MSO habitat in terms of reducing litter/duff cover and stimulating regeneration and growth of native herbaceous vegetation would be eliminated; 3) Treatments within MSO habitat would continue to meet the intent of the 1995 MSO recovery plan 4) Mechanical treatments within the nest roost recovery habitat would follow the denser 150 ft^2 basal area guidance thereby reducing the ability to improve MSO nesting/roosting habitat in terms of sustainability, as indicated by high potential for density related mortality and high bark beetle hazard rating as well as reducing the ability to improve age class and species diversity and the liberation of overtopped oak; 5) Implementation of vegetation treatments within the PACs would take 2 to 3 additional years.; 6) Following existing Forest Plan language concerning MSO population and habitat monitoring or MSO habitat design will not have an effect on the treatments themselves or their outcomes.

Amendment 2:

Effects of Forest Plan Amendment 2 would be the same impacts on fire, fuel and air resources as the direct and indirect effects discussed for the action alternatives. If the amendment did not occur: It would not be technically feasible to treat areas on steep slopes to meet the desired conditions; Manual treatment (hand thinning and piling) would only be able to treat trees up to 9 inches in diameter due to safety concerns; Not treating to the desired condition would not allow for the safe use of prescribed fire on steep slopes in many areas of the project; In areas where prescribed fire could be done in terms of firefighter safety, the fire would not have the desired effect, and would cause high levels of mortality across the burned areas which would not achieve the desired fuels reduction and post fire flooding reductions

Unavoidable Adverse Effects, Irreversible and Irretrievable Commitment of Resources

Unavoidable Adverse Effects, Irreversible and Irretrievable Commitment of Resources would be identical to those discussed under Alternative 2, but to a lesser degree as fewer acres would be treated under Alternative 4.

Air Quality

Air impacts are felt and measured by the concentration of emissions at a given location, be it a town, a house, or an air quality monitor. There are no reliable methods of predicting concentrations at specific locations years in advance of a prescribed fire. This analysis does not attempt or pretend to predict the actual total emissions that would be produced under each alternative. Rather it aims to present a rationale for which alternatives are likely to produce "less" or "more" emissions. It assumes that, over time, there is some degree of correlation between total emission production, and total air quality impacts. Impacts are measured and evaluated based on the concentration of emissions at a specific location, not the total amount of emissions. Though meteorological conditions vary immensely by time of day, time of year, and from one weather system to the next, over the course of years the averaging effect over time of these varying conditions supports a correlation between total emissions and total impacts (Kleindienst 2012). The DLH portion of the project is in the Little Colorado River Airshed, and the MM portion is within the Verde River Airshed. Smoke emitted from a wildfire or a prescribed fire will settle in to drainages adjacent to the units. Diurnal patterns of air movement cause smoke from the DLH area can settle within the greater Flagstaff area, with most of it draining towards the Rio De Flag. Smoke emitted from MM would settle in the Village of Mormon Lake and can drain west towards Munds Park and Munds Canyon, eventually draining to Oak Creek Canyon.

Flagstaff is located to the south of the DLH unit with the housing and neighborhoods immediately adjacent to the project boundary. The Kachina Peaks Wilderness is located north of DLH, and will be treated as a Class I area as indicated in the Forest Plan.

The Arizona Department of Environmental Quality (ADEQ) models emissions/pollutants from all prescribed burning within the state. Any prescribed burn planned by the Forest Service must be approved by ADEQ on a daily basis. ADEQ will not allow more acres burned per day, per air shed, than is acceptable with current air quality forecasts.

When the Forest Service conducts prescribed burning, the burn boss is responsible for monitoring smoke plume trajectories to assure impacts are within predicted values. The burn boss makes changes as needed when unpredicted weather threatens stronger impacts.

Methodology

Affected Environment

There are several highly used FS roads within the project boundaries. Recreationists use these roads in conjunction with Highway 180 and Lake Mary Rd to access many areas on which to recreate within the project areas. Most visitors who take advantage of the recreation opportunities that exist within the project areas do so mostly during the spring, summer, and fall months. Some of these activities include hiking, recreational vehicle camping as well as tent camping, hunting, wildlife viewing, scenic driving, and ATV/UTV use. People also cross country ski, snowmobile, and sled in the selected areas during the winter months (see also the Recreation Specialist Report).

The prevailing winds for the FWPP area are out of the southwest. However, as fronts pass, winds can arrive from any direction for a period ranging from a few hours to three days. Atmospheric inversions can prevent smoke from dispersing. Within the project area, inversions mostly occur between October and December. Stagnant atmospheric conditions result from low mixing heights and light transport winds. These conditions, when they occur, may last from twelve hours to several days (Arizona Department of Environmental Quality, Fort Collins Weather Database).

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Alternative 1 would produce no direct effects since no prescribed burning would occur. However, analyzing the emissions from a high severity wildfire occurring within the project area that has not been treated using the Forest Vegetation Simulator (FVS) and Fire and Fuels Extension (FFE), the amount of fuel consumed and the smoke generated by a high intensity wildfire would be greater than that under Alternatives 2, 3, or 4.

Under extreme weather conditions, a wildfire would mostly likely burn more acres than would generally be burned with a prescribed burn in a day because of the difficulty of suppressing a wildfire in an untreated area. The resulting smoke from such a wildfire would spread wider and farther than with prescribed fire. Nighttime smoke would reach farther and impact the nearby communities more severely. Smoke would exceed air quality standards in both density and duration.

Figure 53: Predicted reduction in potential wildfire emission of PM 2.5 per alternative Dry Lake Hills

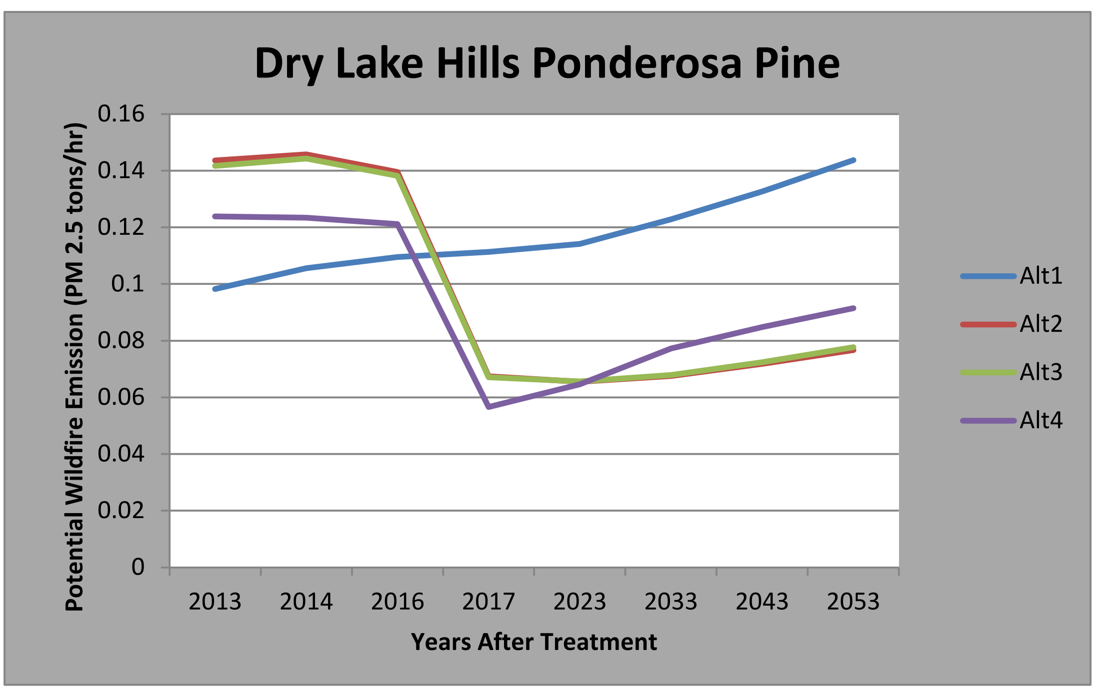
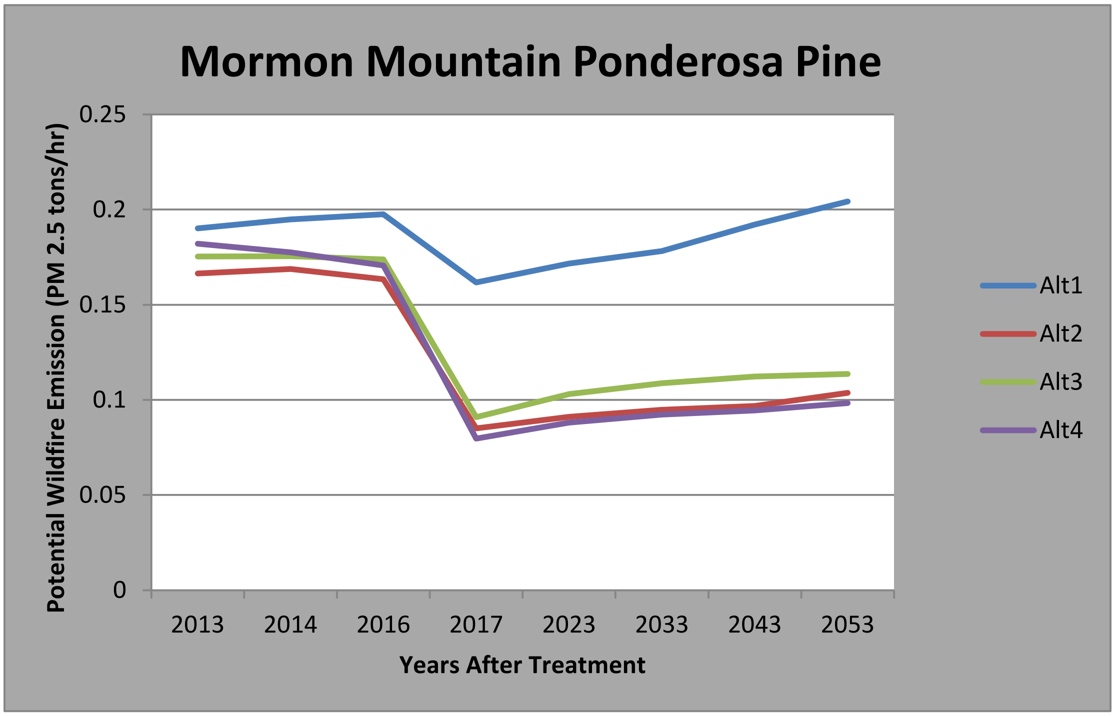


Figure 54: Predicted reductions in potential wildfire emission of PM 2.5 per alternative Mormon Mountain



Cumulative Effects

The cumulative effects boundary for this analysis is defined as the area contained within the Little Colorado River airshed, the Kachina Peaks Wilderness and the Verde River airshed.

Forest health and fuel reduction projects that have occurred in close proximity to the FWPP area have most likely helped with reducing the potential effects of wildfire on the above named airsheds. These fuel reduction projects include Wing Mtn. Hart Prairie, Ft. Valley, A-1, Lake Mary Fuel Reduction, Skunk Fuel Reduction, East Side, and Woody Ridge. However, by not treating FWPP itself, the project area and surrounding untreated forested areas would most likely experience damaging fire effects and produce great quantity of smoke emissions if a wildfire entered into the untreated area under extreme weather conditions.

According to the Flagstaff Zone Dispatch, the Coconino National Forest averages about four hundred wildfires a year. Roughly half of these are human-caused, with the balance caused by lightning. On average there are eighty-five days a year in which multiple wildfires start. The vast majority of these fires are controlled at one-tenth of an acre. Large destructive fires increase the average annual wildfire acres up to four thousand acres a year. Smoke from a wildfire occurring under modeled conditions would exceed air quality standards. As more area is left untreated on the forest, smoke from a wildfire occurring under the No Action Alternative could accumulate with emissions from other wildfires and further exceed air quality standards.

Alternatives 2, 3 & 4

Effects associated with the action alternatives are anticipated to be the same, though to slightly varying degrees according to the differences in acreages proposed for treatment. The effects are discussed together, with differences noted.

Direct & Indirect Effects

Alternatives 2, 3, and 4 seek to reduce the fire hazard while retaining as many nutrients on site as possible. For the Dry lake Hills (Alternatives 2 and 3), prescribed burning is proposed for approximately 5,963 acres of piled slash, and surface fuels on the forest floor using broadcast burning techniques. Alternatives 2, 3, and 4 propose prescribed fire and pile burning on 2,975 acres in the Mormon Mountain unit. Alternative 4 proposes prescribed fire and pile burning on 3,459 acres for Dry Lake Hills. A direct effect of all of the action alternatives is that smoke from prescribed burning will have short-term impacts on local air quality. These effects come from three sources: 1) pile burning of slash generated from thinning; 2) initial entry broadcast burning of the forest floor and; 3) maintenance broadcast burning.

A direct effect of all the alternatives is that smoke from prescribed burning would have short-term impacts on local air quality. These effects come from three sources: 1) pile burning of slash generated from thinning trees, 2) initial entry broadcast burning of the forest floor, and 3) maintenance broadcast burning of the forest floor. Emissions generated by these actions have been modeled using FVS for the project and are found in the proposed treatments per alternative tables (Table 39 and Table 40 for Alternative 2; Table 46 and Table 47 for Alternative 3; and Table 50 and Table 51 for Alternative 4).

Prescribed Fire Effects

Slight differences in prescribed fire effects (flame length, scorch height, mortality and downed woody debris) are evident between Alternatives 2 and 3. This is because Alternative 3 would leave slightly more material on the ground post-implementation compared to Alternative 2 due to the differences in harvesting methods.

Pile Burning

Pile-burning is relatively efficient combustion producing fewer emissions than both wildfires (pre-treatment) and initial entry prescribed burning. An ‘initial entry’ fire is a fire that burns though an area that has not had fire for at least a couple of decades. A result of decades of fuel buildup is a greater volume of emissions per area. Subsequent fires, wildfires or prescribed fires, have less fuel to burn and produce less emissions per area. A direct effect of action alternatives (2, 3, and 4) is that some smoke from pile burning may still subside into the neighborhoods in and around the project area after most of the piles have burned down to 10 percent or less of their original size. Pile burning near subdivisions may cause short-term smoke impacts, usually lasting at the most a day.

Broadcast Burning

The initial prescribed burning of the forest floor produces more emissions than pile burning, but far less than most wildfires burning in the same (pre-treatment) fuel bed (compare Table 36 and Table 37 to Table 39 and Table 40, for example). The initial broadcast burning of each block in the project area would generate smoke for as long as seventy-two hours after ignition. The emissions from implementing would generally meet National and State Ambient Air Quality Standards because burning would only occur under weather conditions that are favorable for burning and on a certain number of acres of land that would reduce smoke impacts to surrounding areas.

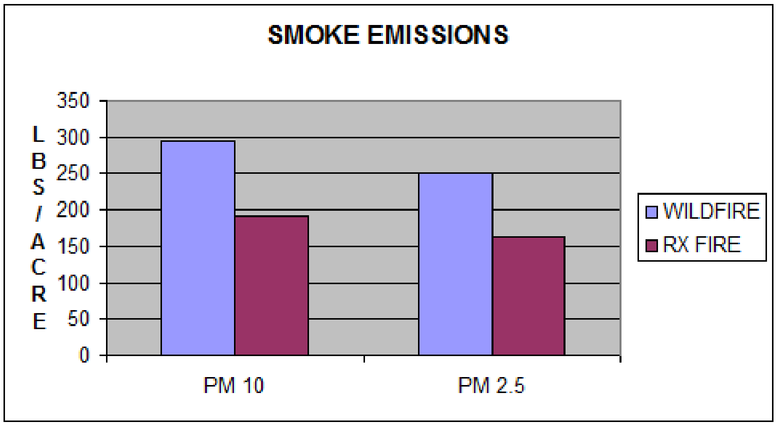
Once initial entry burning has occurred, successive maintenance burns would be implemented every five to seven years in the ponderosa pine to mimic the historic fire regime. These maintenance burns would generate less smoke volume, be shorter in duration, and have less smoke after sunset compared to that created by an initial prescribed burn and far less than that created by a wildfire.

The high level of recreation activity that occurs in the summer months in and around the DLH area is not likely to be impacted by smoke because very little to no prescribed burning would be conducted during the summer. Recreationists visiting the project area and surrounding areas in the fall and spring could be impacted by smoke from prescribed burning. The smoke impact could last for as long as seventy-two hours during initial entry broadcast burning, but usually only six hours during maintenance burning.

Smoke plume trajectories indicate that the communities within and adjacent to the project area and Highway 180 and Lake Mary RD may be impacted by smoke when burning. Short-term air quality degradation and reduced visibility may be experienced. After sunset, cooling atmospheric conditions would carry smoke down drainages. These down-canyon flows typically reach the communities around the project area in the early morning hours.

The early morning flows may carry smoke down slope and reduce visibility in surrounding low lying areas when blocks adjacent to these areas are being burned. These portions would be posted with appropriate signs warning residents living adjacent to the project area, forest visitors, and motorists of reduced visibility. Ignition of each day’s block would be completed in the afternoon, thus limiting the smoke generated after atmospheric cooling begins. Smoke impacts would be much worse should a wildfire occur under modeled weather conditions without the implementation of the proposed action. These impacts are shown below.

Figure 55: General Smoke Emissions for a particulate matter[25] 10 and 2.5 for prescribed fire and wildfire on the Coconino NF



The reduction in the fuel load and the increased openness of the canopy would allow future broadcast burning under a wider range of weather conditions than the existing conditions. The ability of fire managers to limit undesirable smoke impacts is increased by having a wider range of weather parameters within which to burn. Areas that have been thinned mechanically would allow a wider range of weather conditions than unthinned forested areas, and would have a lower risk of smoke impacts because the canopies have been opened up, allowing for better ventilation and smoke dispersal. Forested areas thinned by hand would allow the next widest range of areas determined to need thinning. Areas receiving burn only treatments may or may not have an open canopy depending on their existing condition. Burning in stands that are not thinned and have high canopy closures will most likely produce the heaviest smoke impacts. Potentially heavy smoke impacts would be avoided by burning on days with favorable ventilation as regulated by the Arizona Department of Environmental Quality (ADEQ).

Cumulative Effects

The cumulative effects for air quality for the project, the area contained within the Little Colorado River airshed, Kachina Peaks Wilderness and the Verde River airshed were considered as those are the primary areas that would be affected by prescribed burning within the FWPP area.

Smoke emitted from a wildfire occurring after treatment under alternative two would be unlikely to exceed air quality standards by itself. However, it could combine with the emissions of other wildfires that may be burning simultaneously in the same airshed. The accumulation of smoke from multiple wildfires inside and outside the project area might exceed air quality standards, which would serve as a cumulative effect for this project.

The other fuel reduction projects that are currently being implemented adjacent to the FWPP area also include burning activities, which may affect the Little Colorado River and Verde River airsheds (Hart

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[25] Particulate matter consists of inhalable coarse particles (>2.5 and <10 micrometers) and fine particles (=<2.5 micrometers in diameter) (http://www.epa.gov/pm/)

Prairie, Ft. Valley, A-1, Lake Mary Fuel Reduction, East Side, Woody Ridge, Mormon Lake Basin, Mint, Rocky, Munds Park, Mountainaire, Marshall, Elk Park and Kachina). However, the purpose of ADEQ regulation of daily burning in multiple areas within an airshed is to limit smoke impacts to that and any adjacent airsheds.

Since ADEQ limits the total number of acres burned per day per airshed through the amount of burn approvals issued on a daily basis, daily emissions from prescribed burning do not accumulate to exceed air quality standards. The number of days per year in which prescribed burning occurs is likely to increase as projects are implemented, but exceeding air quality standards would not be an effect due to ADEQ daily approval burning limits. Furthermore, these projects combine to reduce future smoke impacts.

Smoke from pile burning may combine with smoke from wood-burning stoves and automobile smoke on some days when inversions are strongest during the winter.

In sites with more closed canopies, forest floor fuel accumulates more quickly. In sites where canopies are denser, prescribed burning can only be executed under a narrower window of weather conditions. Thus, denser canopies result in fewer opportunities to prescribe burn. In turn, fuel accumulates on the forest floor when not burned frequently; thereby resulting in greater smoke impacts than when burning conditions can be met and prescribed burning of the fuel bed takes place.

Unavoidable Adverse Effects, Irreversible and Irretrievable Commitment of Resources

There would be impacts to air quality associated with the implementation of the proposed prescribed fire treatments; however National Ambient Air Quality Standards (NAAQS) would not be exceeded. Before any prescribed fires can be implemented, a prescribed burn plan must be written and signed by the authorizing line officer. For prescribed fire, burn plans include burn techniques, prescriptions, Emission Reduction Techniques, etc. that would be expected to maintain emissions levels at acceptable levels. Approval to burn on a given day must be approved by the Arizona Department of Environmental Quality (ADEQ) before a burn can be initiated. None of the proposed actions under this alternative are expected to exceed NAAQs, though nuisance smoke may increase to the degree that the public would tolerate as discussed in the Air Quality section of in this report.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

The effects of the proposed Forest Plan amendments would be the same as those discussed under Fire and Fuels.

Forest Structure and Health

Methodology

Issues and Indicators

Issues serve to highlight effects or unintended consequences that may occur from the proposed action, giving opportunities during the analysis to reduce adverse effects and compare trade-offs for the decision-maker and public to understand. Key issues pertaining to forest structure and health (also referred to as Silviculture) identified during scoping and the indicators used to evaluate the issue are:

- Quantitative pre-treatment and post-treatment three-level analysis for Mexican spotted owl, goshawk, old growth, and vegetation structural stage (VSS) for goshawk habitat at the landscape scale (ponderosa pine vegetation type) to gauge movement towards restoration desired conditions
- Pre-treatment and post-treatment distribution of habitat structure within goshawk habitat evaluated at three scales: project level, stand, and group (or point level, equivalent to a stand exam plot).
- Overall habitat structure (VSS class) and forest density metrics (basal area, stand density index and trees per acre) averaged to a per-acre basis with averages including openings, canopy gaps, and all forest structural stages.
- Density stocking guides that would be used to meet the VSS class canopy cover requirements within goshawk post-fledging family areas (PFAs) and landscapes outside of post-fledging family areas (LOPFA).

Data Collection

The base unit for characterizing vegetation conditions is the stand. All forested lands within the Coconino National Forests have been delineated into stands based on similar characteristics such as vegetation type, slope, aspect, tree density, species composition and management history. Stands vary in size depending upon their uniformity, usually from 10 acres up to several hundred acres.

Comprehensive tree data has been collected on a subset of the stands within the project area over the last 30 years. Within each sampled stand, tree characteristics were measured at sample points, using both variable basal area factor plot and fixed plot designs. Specific tree data collected include species, class, diameter, height, age, growth, damage and disease. Other data sometimes collected, depending on design, include surface fuels and understory plant species. This stand data is currently stored in the Field Sampled Vegetation (FSVeg) database. A thorough review of the stand data was done for the project area to ensure validity. Data that did not match on the ground conditions or minimum sampling intensity was culled.

Tree data used within for the DLH portion of the vegetation analysis came from stand exam data (discussed above) and by averaging stand data from adjacent stands to populate vegetative data to stands for which stand exam data was not available. Within the MM portion, vegetation analysis came from stand exam data (discussed above) and the Most Similar Neighbor (MSN) Analysis computer program within the INFORMS model. The MSN analysis data used for this project (within the MM area) is from the same analysis that was conducted and generated by the 4FRI analysis. Refer to the 4FRI Silviculture specialist report for further explanation of the model and their analysis methods (McCusker 2012).

All of the stand data collected in 2013 or earlier was then compiled into a database and modeled in the Forest Vegetation Simulator (FVS) tree growth model and updated to the year 2013. This process allowed us to characterize the current stand conditions and determine the need for change and appropriate treatments based on the project purpose and need. The FVS was then used to simulate cutting and prescribed burning treatments and growth following treatment for each alternative up to the year 2053.

Modeling

The FVS is a model used for predicting forest stand dynamics throughout the United States and is the standard model used by various government agencies including the USDA Forest Service, USDI Bureau of Land Management, and USDI Bureau of Indian Affairs (Dixon 2002). The FVS is an individual tree, distance independent growth and yield model with linkable modules called extensions, which simulate various insect and pathogen impacts, fire effects, fuel loading, snag dynamics, and development of understory tree vegetation. FVS can simulate a wide variety of forest types, stand structures, and pure or mixed species stands (Keyser and Dixon 2008). Forest managers have used FVS extensively to summarize current stand conditions, predict future stand conditions under various management alternatives, and update inventory statistics.

For simulation purposes, each data set was grouped by current forest type and treatment type. Simulations were developed for each treatment based on desired conditions. A multitude of vegetation and fuels attributes were computed for each growth cycle, including tree density (trees per acre, basal area and stand density index) by species or species groups and VSS size class, dwarf mistletoe infection, cubic feet of biomass removed, canopy base height and bulk density, live and dead surface fuel loading, live and dead standing wood, coarse woody debris and snags. These attributes were then averaged for all the data sets represented in the simulation. The averaged computed attributes from FVS were also used to calculate other attributes such as dominate VSS size class, canopy density and even-aged or uneven-aged structure. All of these attributes were then compiled into an “effects” database by alternative and used to analyze and display the direct and indirect effects to the vegetation resource. For Alternative 4, areas that are not proposed for treatment were not averaged into modeling.

The following is a list of general modeling assumptions. The Silviculture Specialist Report contains more information about the modeling assumptions specific to each treatment type in the proposed action.

- All tree data was grown to the common year of 2013 and is considered to represent the existing condition.
- All tree cutting and removal was modeled in the year 2013.
- For those stands which would be burned, prescribed burns were modeled in the year 2016.
- After treatment, the tree data was grown to the common year of 2033 and 2053 and is considered to represent the post treatment condition.
- The tree data does not indicate tree age. Simulations use diameter as a surrogate for age based on the vegetative structural stage definitions. We acknowledge that there are trees on the landscape where age class does not fit in the size class; however these are generally thought to be a small minority of trees. For example there may be young trees that are larger than 11.9 inches dbh; mid-aged trees that are larger than 17.9 inches dbh; or mature trees that are less than 18 inches dbh.
- The modeling assumptions attempt to meet the spirit of the 4FRI stakeholders Large Tree Retention Strategy (LTRS) within the limitations of a non-spatially explicit model. On the ground cutting prescriptions for Alternatives 2 and 3 would follow components of the LTRS that have been incorporated into the design features of this EIS, including those related to old tree retention. Alternative 4 would include more specific limitations on large tree removal per the LTRS, as that alternative adopted a modified version of that strategy.
- All cutting simulations assume 15 percent of the cut stems are left on site and 10 percent of the branchwood from the cut and removed stems is left on site. All other biomass resulting from the cutting is assumed to be removed, either through prescribed burning or biomass utilization.
- Default parameters within the model were used to predict tree mortality and dwarf mistletoe infection intensification.
- Snags and coarse wood amounts are based on the inventory or default parameters within the model if they were not inventoried. Snag fall rates and changes in surface fuels are based on default parameters.

- In cutting simulations where cable yarding is proposed, approximately 10% of all species and size classes are cut to simulate the effect caused by the creation of cable corridors. All snags in cable yarding simulations are assumed to be cut and left on the ground due to operational safety requirements.
- In helicopter harvesting simulations, the analysis assumes that all snags in those units would be cut and left on the ground due to operational safety requirements.
- When calculating and averaging data, untreated areas were not averaged in with treatment areas.

Modeling Limitations

Stand exam data is an average characterization of tree and other measurements within the stand boundaries. It is limited by sampling intensity and the variability within the sampled area.

FVS is not spatially explicit and cannot model tree groups and openings within stands. The modeling results are an average approximation of the desired forest structure.

Results from the FVS model depend upon sample data, validity of the model itself and assumptions made by the modeler.

Output from the FVS model used in this analysis is a characterization of the existing condition and relative change over time of management actions or no action. Absolute conditions are neither intended nor implied.

Vegetative Structural Stage (VSS)

Vegetation structural stage (VSS) is a method of describing the development stages of a stand of living trees and is a generalized description of forest age and tree size from seedling to old forests. It is an integrative approach, combining vegetation and forest growth, to describe southwestern forests. Six vegetation structural stages (VSS) have been defined primarily on tree diameters and are based on the time it takes seedlings to become established and subsequent growth rates (Table 56). Life expectancy of trees determines how long the oldest VSS can be maintained (Reynolds et al. 1992). The VSS classification is based on the tree size class with the highest square foot of basal area, which includes all tree species.

The VSS classification was further defined to include a measure of tree canopy density and age class heterogeneity along with the dominant diameter distribution. Age class is a measure of the variety of age classes present in relation to the dominant age class and is an indication of canopy layers. A single storied stand resembles an even-aged condition while multiple storied stands are considered uneven-aged. Table 56 describes the VSS coding as defined by the Compendium of NFS Regional Vegetation Classification Algorithms (Vandendriesche 2010).

Table 56: Description of Vegetation Structural Stages (VSS)

VSS (DBH Size Class)	Structural Stage
1 (0-.9”)	Grass/Forb/Shrub
2 (1.0-4.9”)	Seedling/Sapling

VSS (DBH Size Class)	Structural Stage
3 (5.0-11.9”)	Young Forest
4 12.0-17.9”)	Mid-age Forest
5 (18-23.9”)	Mature Forest
6 (24”+)	Old Forest

The following three-scales of VSS were used for the analysis of goshawk habitat areas outside of MSO habitat.

Small Scale: For the small-scale VSS analysis, stand exam data from all the stands with in the treatment area were analyzed using point (plot) level data. Points were evaluated and given a point-level VSS designation. The Forest Vegetation Simulator was used to calculate the average basal area per acre within each VSS class for each of these points. The point-level VSS designation represents the VSS class that contained the highest basal area. These point-level VSS designations, once evaluated and analyzed, were then used to conduct the small-scale analysis. The point level data was broken out into LOPFA, PFA, and nest groups. This analysis is displayed in Table 67.

Mid-Scale: For the mid-scale VSS analysis, stand exam data from all the stands within the treatment areas were evaluated and given a stand-level VSS designation. The Forest Vegetation Simulator was used to calculate the average basal area per acre within each VSS class for each of these stands. The stand-level VSS designation represents the VSS class that contained the highest basal area. The list of VSS designations for each stand is too extensive to place in this document, but can be found in the project record. These stand-level VSS designations, once evaluated and analyzed, were then used to conduct the mid-scale analysis. The data was grouped by stands into LOPFA, PFA, and nest areas. This analysis is displayed in Table 68.

Landscape Scale: For the large-scale VSS analysis, all the stand level data for the entire goshawk habitat within the project area was averaged to come up with one average value. Table 69 displays the large-scale analysis data.

Stand Density

Measures of stand density used in this analysis are basal area, trees per acre and stand density index (SDI). Basal area (BA) is the cross-sectional area of all trees, measured in square feet per acre and trees per acre (TPA) is simply a count of the total number of trees on an acre. These simple measures of stocking do not give an indication of tree sizes and therefore can be biased when used to determine how site resources are being used.

SDI is a relative measure of stand density based on the number of trees per acre and the mean diameter (Reineke 1933). SDI expresses the actual density in a stand relative to the theoretical maximum density possible for trees of that diameter and species. By taking both tree size (DBH) and numbers (TPA) into account, SDI is a good indicator of how site resources are being used.

Long (1985) divided SDI percentages into four zones that consider the percent of a stand occupied by trees. Table 57 displays the amount of tree competition and growth based on stand density percentages (percent of maximum stand density index). Based upon established forest density/vigor relationships, density-related mortality from competition begins to occur once the forest reaches 45-50 percent of maximum stand density (zone 3), and mortality is likely at density levels of 60 percent or more of maximum stand density (zone 4).

Table 57: Relationships of Forest Density to Forest Stand Development and Tree Characteristics

% Maximum SDI*	Zone	Forest Stand Development and Tree Characteristics
0 – 24% Low Density	1	Less than full site occupancy, maximum understory forage production. No competition between trees, little crown differentiation. Maximum individual tree diameter and volume growth. Minimum whole stand volume growth.
25 – 34% Moderate Density	2	Less than full site occupancy, intermediate forage production. Onset of competition among trees, onset of crown differentiation. Intermediate individual tree diameter and volume growth. Intermediate whole stand volume growth.
35 – 55% High Density	3	Full site occupancy, minimum forage production. Active competition among trees, active crown differentiation. Declining individual tree diameter and volume growth. Maximum whole stand volume growth. **Upper range of zone marks the threshold for the onset of density-related mortality.**
56+% Extremely High Density	4	Full site occupancy, minimum forage production. Severe competition among trees, **active competition-induced mortality.** Minimum individual tree diameter and volume growth, stagnation. Declining whole stand volume growth due to mortality

Canopy Cover

Canopy cover is defined as “the percentage of a fixed area covered by the crowns of plants delimited by a vertical projection of the outermost perimeter of the spread of foliage” (Reynolds et al. 1992). Canopy cover is often viewed as a meaningful expression of stand conditions relating to habitat suitability as well as tree overstory/herbaceous understory relationships; however because it is spatial in nature, non-spatial analysis may or may not be useful. In the southwest, canopy cover estimates figure in management recommendations for both the Mexican spotted owl (USDI Fish and Wildlife Service 2012) and the northern goshawk (Reynolds et al. 1992). For this project, there are specific Forest Plan canopy cover guidelines for goshawk habitat and old growth that apply to mid-aged and old forest structural stages (VSS 4, 5 and 6) and not to grass/forb/shrub and young forest structural stages (VSS 1, 2 and 3).

Canopy cover is time consuming to measure and difficult to standardize to obtain consistent results with different observers. Even the definition of the term is dependent on the method of measurement. Percent canopy cover for all the analysis within this document was determined using the average basal area (BA) as calculated by FVS. For small scale analyses BA was calculated by FVS at the point level. For mid-scale and large-scale analysis, BA was calculated by averaging the BA of all the points within that stand. A study by Shepperd et al. (2002) used vertical crown projection to develop an algorithmic relationship to estimate canopy cover based on the average stand basal area. Average percent canopy cover for each stand was calculated using the following formula developed by this study:

*Canopy cover = -57.44 + 25.5047 * LN(BA)*

Initial FVS runs for mixed conifer stands calculated canopy cover values that were lower compared to observed canopy cover and may not reflect the true canopy cover in the stands themselves. Since canopy cover assessment includes not just the number and size of tree crowns, but also the spatial arrangements of the trees on the land, non-spatial models such as FVS and equations may not accurately reflect true conditions on the ground. To assess the canopy cover of mixed conifer, the crown width of ponderosa pine, Douglas-fir, white fir and limber pine were measured from trees within the project area in all size classes for each species. The crown widths were not significantly different between species. Based on this assessment, it was decided to use the above formula to calculate canopy cover from the average stand basal area.

While specifying the desired percentage distribution of VSS forest and canopy cover requirements, the Forest Plan is ambiguous on which scale measurements should be taken. The Forest Plan states that canopy cover guidelines should be applied to VSS 4-6 forest groups (Forest Plan p. 65-9), but does not specifically say at which level canopy cover should be measured to show compliance with this guideline. As a result, it is our professional judgment that canopy cover should be calculated at the group level to show that canopy cover requirements are meeting or moving toward canopy cover guidelines for VSS 4, 5, 6 forest groups. The Forest Plan also says that 'canopy cover is measured with vertical crown projection on average across the landscape (Forest Plan 65-9),' thus this NEPA document also discloses canopy cover measurements at larger scales for areas that also include forest groups in VSS 1, 2, 3.

Multiple VSS groups can be found within a single uneven-aged stand; therefore, a stand-level approach is not useful as it averages multiple VSS group structures and thereby classifies the stand as a single VSS class, which doesn't reflect the stand's uneven-aged characteristics. All openings are either considered in canopy cover calculations for VSS 4-6 or considered to be a part of VSS 1. Table 58 lists the stocking guides that would be used to meet canopy cover requirements in tree groups within goshawk LOPFA habitat.

Table 59 lists the stocking guides that would be used to meet canopy cover requirements in tree groups within goshawk PFA habitat.

Table 58: Stocking Guides to Meet Tree Group Canopy Cover Requirements within Goshawk Habitat Areas Outside of PFAs (LOPFA)

		Typical Number of Trees Per Group Stocking for Different Group Sizes[1]					Typical Intra-Group (within-group) Densities[1] (All Group Acreage Sizes)	
VSS	DBH Range	1/10 acre group	1/4 acre group	1/2 acre group	3/4 acre group	1 acre group	Relative Spacing Range (feet)	Basal Area[2] (ft^2/acre)
1 & 2	0 - 4.9”	19	48	96	144	193	12 – 18	N/A
3	5 - 11.9”	11	28	55	83	110	N/A	43
4*	12 - 17.9”	4	9	19	28	37	N/A	45
5*	18 - 23.9”	3	6	13	19	25	N/A	60
6*	24”+	3	6	12	18	24	N/A	95

[1]These are typical values for the desired condition; variation can occur and is desired. However, ranges should center on these values. See chart below.
[2]Rounded to nearest 10 square feet/acre.
* Densities are equivalent to 40% canopy cover.

Table 59: Stocking Guides to Meet Tree Group Canopy Cover Requirements within Goshawk PFAs

		Typical Number of Trees Per Group Stocking for Different Group Sizes[1]					Typical Intra-Group (within-group) Densities[1] (All Group Acreage Sizes)	
VSS	DBH Range	1/10 acre group	1/4 acre group	1/2 acre group	3/4 acre group	1 acre group	Relative Spacing Range (feet)	Basal Area[2] (ft^2/acre)
1 & 2	0 - 4.9”	19	48	97	145	193	12 – 18	N/A
3	5 - 11.9”	16	39	78	117	156	N/A	60
4*	12 - 17.9”	7	18	37	55	73	N/A	90
5**	18 - 23.9”	4	11	22	33	44	N/A	105
6**	24”+	3	8	15	23	30	N/A	120

[1]These are typical values for the desired condition; variation can occur and is desired. However, ranges should center on these values. See chart below.
[2]Rounded to nearest 10 square feet/acre.
* Densities are equivalent to 55% canopy cover
** Densities are equivalent to 50% canopy cover

Affected Environment

This section will talk about the existing conditions specific to MSO and northern goshawk habitat. See the Forest Structure and Forest Health Existing Conditions section of Chapter 1 for more discussion of the current conditions for other silvicultural resources within the project area, including aspen, old growth, forest health etc.

Mexican Spotted Owl and Northern Goshawk Habitat

All ponderosa pine forested habitat within the analysis area was stratified to meet analysis requirements in the Forest Plan and the revised recovery plan for Mexican spotted owl (MSO). Stratification of acres by habitat and forest type is displayed in Table 60 (MSO) and Table 61 (goshawk). While both the DLH and MM areas have designated goshawk PFAs and nests, only DLH has goshawk habitat outside of MSO habitat.

Table 60: MSO Habitat Stratification within the Analysis Area (Acres within each project site) under the 2012 MSO Recovery Plan.

MSO Habitat	DLH	MM	Total
Protected Activity Center			
Protected Activity Center (Outside of Nest/Roost Core)	1398	1772	3170
Nest/Roost Core	383	402	785
Total MSO PAC:	1781	2174	3955
Recovery Habitat			
Pine Oak	277	767	1044
Mixed Conifer	1800	0	1800
Nest/Roost	109	22	131
Total MSO Recovery Habitat:	**2186**	**789**	**2975**
Total MSO Habitat	**3967**	**2963**	**6930**

Table 61: Northern Goshawk Habitat Stratification within the Analysis Area (Acres by project site)

Northern Goshawk Habitat	DLH
Nest Habitat	45
Post-fledging Family Area (PFA)	178
Landscapes Outside Post-fledging Family Areas (LOPFA)	1739

Northern Goshawk Habitat	DLH
Total Goshawk Habitat	**1962**

Mexican Spotted Owl Habitat – Forest Density and Structure

The Protected Activity Centers (PACs) provide the best possible nesting/roosting owl habitat available with the nest or activity center located near the center. The recovery habitats are managed to ensure a sustained level of both foraging and nest/roost habitat distributed across the landscape. Table 62 displays the total basal area, percent of basal area by size class, tree per acre greater than 18 inches dbh and Gambel oak basal area as a percent of total basal for all MSO habitats. These structural attributes and habitat components are indicators of nest/roost characteristics as outlined in the revised MSO Recovery Plan (USDI FWS 2012).

MSO Nest Fuels Reduction & MSO Nest/Roost Recovery: Residual basal area would be a minimum 110 ft^2 in the Nest Cores and 95 ft^2 in Nest/Roost Recovery stands. Treatments would maintain a minimum of 60 percent canopy cover in mixed conifer. Post-treatment, a minimum of 12 trees greater than 18 inches dbh per acre would be present; trees greater than 12-18 inches dbh would comprise over 30 percent of stands, per the MSO Recovery Plan guidelines (2012).

Table 62: Existing Spotted Owl Habitat Forest Structure and Habitat Components

Habitat	Project Site	Cover Type	Basal Area	Avg. Percent of Basal Area by Size Class 12.0 – 17.9”	Avg. Percent of Basal Area by Size Class >18.0”	Avg. TPA 18”+	Avg. Gambel Oak BA Percent of Total BA	Tons CWD	Snags >18”
Recovery Habitat – Nest/Roost	DLH	Mixed Conifer	145	47%	10%	3.3	0%	37.6	3
	MM	Pine/Oak	173	17%	60%	39	14%	17.5	1.3
Recovery Habitat-Foraging Non-Breeding	DLH	Mixed Conifer	142	33%	28%	15	1%	23.3	3.7
		Pine/Oak	136	41%	30%	15.6	24%	13.4	.2
	MM	Pine/Oak	161	41%	26%	16	12%	11.8	.5
MSO PAC Habitat	DLH	Mixed Conifer	135	31%	28%	14	0.7%	26.9	4.0
		Pine	130	23%	63%	22	0	9.9	5.5
	MM	Mixed Conifer	153	23	39%	22	16%	27	9.2
		Pine/Oak	161	38%	20%	12.4	16%	14	.9
MSO PAC Habitat – Nest	DLH	Mixed Conifer	132	26%	36%	19	3%	25	3.3

Habitat	Project Site	Cover Type	Basal Area	Avg. Percent of Basal Area by Size Class		Avg. TPA 18"+	Avg. Gambel Oak BA Percent of Total BA	Tons CWD	Snags >18"
				12.0 – 17.9"	>18.0"				
Core		Pine	55	48%	36%	8	0	3.7	1.7
	MM	Mixed Conifer	140	23%	36%	20	18%	24	9.4
		Pine/Oak	146	45	17%	10	12%	11.2	0.5

Northern Goshawk Habitat – Forest Density and Structure

The post-fledging family areas (PFA) consist of nest sites and adjacent habitat most likely to be used by fledgings during their early development as well as unoccupied suitable habitat within a 2 to 2.5 mile range of PFAs. Mixed conifer and pine/oak vegetation types would be managed for MSO protected or recovery habitat; which encompasses all of MM and a large portion of the DLH area. The remaining ponderosa pine forest outside of MSO PACs, MSO recovery habitat areas, and goshawk PFAs is considered goshawk foraging habitat and will be referred to as Landscapes Outside of Goshawk Post-fledging Family Areas (LOPFA) for the remainder of this report.

The existing distribution of forest structure, habitat components and structural stages within northern goshawk habitat was evaluated at three scales: Project extent, stand level, and plot level (see also the Methodology section of the Forest Structure and Forest Health in Chapter 3).

Table 63 and Table 64 display the existing forest structure and habitat components for goshawk forest habitat at the stand level in the DLH; though goshawk habitat is present on MM, it's overlapped by MSO habitats and thus not shown on the tables below. These structural attributes and habitat components are indicators of goshawk habitat (PFA and LOPFA) characteristics as outlined in the Forest Plan.

Table 63: Existing Goshawk Nest/PFA Habitat Forest Structure and Habitat Components

Project Site	Basal Area	Canopy Cover	TPA	SDI % of Max.	Snags >18"
DLH	137	70%	308	51%	1.2

Table 64: Existing Goshawk LOPFA Habitat Forest Structure and Habitat Components

Project Site	Basal Area	Canopy Cover	TPA	SDI % of Max.	Snags >18"
DLH	132	69%	314	54%	1.2

All goshawk habitat was assessed to determine the variety of tree size/age classes present in relation to the dominant size/age class (Table 65 and Table 66). Those stands with one or two classes present have even-aged structure, and those stands with three or more classes present have uneven-aged structure. Forest Plan direction for goshawk habitat outside of nest stands is to manage for uneven-aged stand conditions made up of smaller (plot level) even-aged tree "groups" of live trees. Based upon this direction, the existing even-aged forest structure at the stand scale is not desired for goshawk forest habitat outside of nest stands.

Table 65 and Table 66 demonstrate the distribution of the dominate vegetation structural stages for all stands within each of goshawk habitats and age class strata. This is an indication of structural stage diversity throughout the goshawk habitat. Since the stand level structural stage is based on the tree size class with the highest square foot of basal area, it is a true description of age class diversity in even-aged stands; however in uneven-aged stands it does not give a complete portrayal. This is due to the fact that within uneven-aged stands, there are three or more age classes present and the dominant VSS class only tells us which one has the highest basal area.

The 1987 Coconino National Forest Plan direction for goshawk habitat outside of nest stands is the following distribution of vegetation structural stages: 10 percent each grass/forb/shrub (VSS 1) and seedling-sapling (VSS 2), and 20 percent each young forest (VSS 3), mid-aged forest (VSS 4), mature forest (VSS 5) and old forest (VSS 6).

The even-aged stands are dominated by the young and mid-aged forest structural stages (over 85 percent within the LOPFA and 80 percent in the PFA) with very little representation of the other structural stages.

The existing uneven-aged forest structure does not comprise a balance of VSS classes. The young and mid-aged forest structural stages are surplus, and the grass/forb/shrub, seedling-sapling, mature and old forest stages are deficit relative to Forest Plan direction.

Table 65: Existing Forest Structure – Goshawk LOPFA Stands Percent of Area by Vegetative Structural Stages.

Project Site	1 – Grass/Forb/ Shrub (0.0 - 0.9”)	2 – Seedling/ Sapling (1.0 - 4.9”)	3 – Young Forest (5.0 - 11.9”)	4 – Mid-age Forest (12.0 - 17.9”)	5 – Mature Forest (18.0 - 23.9”)	6 – Old Forest (24.0” +)
DLH	0%	0%	32%	53%	8%	7%

Table 66: Existing Forest Structure – Goshawk PFA/Nest Stands Percent of Area by Vegetative Structural Stages.

Project Site	1 – Grass/Forb/ Shrub (0.0 - 0.9”)	2 – Seedling/ Sapling (1.0 - 4.9”)	3 – Young Forest (5.0 - 11.9”)	4 – Mid-age Forest (12.0 - 17.9”)	5 – Mature Forest (18.0 - 23.9”)	6 – Old Forest (24.0” +)
DLH	0%	0%	41%	40%	0%	19%

Environmental Effects

This section describes the proposed treatments and the effects of those treatments on the vegetation resource by characterizing the post treatment condition over time for each alternative. This section also evaluates each alternative in terms of moving toward the desired vegetation conditions. As the desired conditions and treatment area are the same under Alternative 2 and 3, their effects to Silviculture resources are similar and so are discussed together. The differences due to harvesting methods are included in that discussion. When treatments are the same under all action alternatives, Alternative 4 is also grouped into the discussion under a subheading of “Effects Common to All Action Alternatives.” Because of the geographic distance between the two project areas (Dry Lake Hills and Mormon Mountain) and the distinct habitat conditions of each area, this section analyzes each area independently.

Environmental effects of each alternative on the ponderosa pine and mixed conifer cover types found within the project area are discussed first, followed by grasslands, aspen, old growth and forest health. The ponderosa pine and mixed conifer vegetation types are further divided by MSO habitat and northern goshawk habitat, followed by an analysis of all MSO habitat in each portion of the project to provide a look at overall effects from a biological perspective. This is because management of the vegetation types differs, and management is guided by the desired conditions for first MSO, and second northern goshawk, where goshawk habitat does not overlap with MSO.

This section also contains a general discussion of cumulative effects for all action alternatives and the No Action Alternative.

Alternative 1: No Action

Direct & Indirect Effects

Ponderosa Pine – Dry Lake Hills

Under the No Action Alternative, forest areas would remain in an even-aged condition; stands would continue to be dominated by VSS 3 and 4 size classes. Mature and old forest conditions would continue development at a slow pace and would be at risk of increased rates of mortality (Ritchie et al. 2008, Davis et al. 2007).

Over 40 years, canopy cover would increase, basal areas would increase, and trees per acres would decrease. Closed crown canopies result in decreased sunlight to the forest floor, decreased understory productivity and diversity, increased inter-tree competition, decreased tree health, growth and vigor, increased insect and disease-related mortality especially in older age classes, decreased understory productivity and diversity, and decreased horizontal heterogeneity. Number of medium and large sized snags would increase overtime due to competition-induced mortality.

Table 71 and Table 72 show the modeling results of the action alternatives and the No Action Alternative grown out 20 and 40 years from the time of treatment. Under the No Action, the LOPFA and PFA stands would still have an even-aged stand structure. The nest stand would still be a VSS4. In this alternative, stand conditions would continue to have high density, which contributes to competition induced mortality occurring and increases the bark beetle hazard. It also reduces the likelihood of development of mid-aged trees to large trees with old growth characteristics. Stands would be dominated by VSS 4, 5 and 6 size classes and would still be an even-age stand.

While it is not displayed in the tables below, the stand exam data shows that there is a severe dwarf mistletoe infection in the MSO PAC Fuels Reduction treatment areas. This has caused the No Action density numbers to decline as opposed to going up as expected. The severe level of dwarf mistletoe infection would decreases the ability of the stand to maintain high levels of canopy cover and would reduce the rate of tree growth, thus limiting the ability of the stand to maintain large trees and high canopy cover.

Ponderosa Pine – Mormon Mountain

The current stand conditions are shown in Table 73. Stand conditions under the No Action Alternative for 20 and 40 years from now are shown in Table 74 and
Table 75. Current conditions show that all the ponderosa pine stands have high BA, ranging from 146 to 173 ft^2, which means canopy cover is high. All treatment areas have very high numbers of trees per acre, ranging from 600 to 1210 TPA. All these factors contribute to the percent max SDI being well into the extreme range of density, which means that these stands are likely to experience higher levels of tree mortality and high levels of insect infestation and disease.

Under the No Action Alternative, forested areas would remain in an even-aged condition; stands would continue to be dominated by trees in the 5 to 18 inch dbh size classes. Mature and old forest conditions would continue development at a slow pace and be at risk of increased rates of mortality (Ritchie et al. 2008, Davis et al. 2007).

Over 40 years, canopy cover would increase, basal areas would increase, and trees per acres would decrease. Closed crown canopies result in decreased sunlight to the forest floor, decreased understory productivity and diversity, increased inter-tree competition, decreased tree health, growth and vigor, increased insect and disease-related mortality especially in older age classes, and decreased horizontal heterogeneity. Gambel oaks would continue to be shaded out and decline as a result of competition induce mortality from ponderosa pine. The number of medium and large sized snags would increase overtime due to competition-induced mortality.

Mixed Conifer – Dry Lake Hills

The current stand conditions are shown in Table 68. Stand conditions under the No Action Alternative for 20 and 40 years are shown in Table 71and Table 72. Current conditions show that the majority of mixed conifer stands have high BA, ranging from 122 to 157 ft^2, which means that canopy cover is also high. All treatment areas also have very high numbers of TPA, ranging from 476 to 2986. These factors contribute to most of the mixed conifer areas being in the extreme range of density of percent max SDI. The majority of the mixed conifer stands are uneven-aged with trees in all size classes.

Under the No Action Alternative, ponderosa pine and aspen would not be able to regenerate in the current closed canopy conditions and would continue to slowly die out of the stands. In the absence of disturbance or fires, white firs and Douglas-firs would continue to increase and eventually dominate the overstory. In the absence of fire, shade tolerant species such as white fir and (to a lesser extent) Douglas-fir would continue to regenerate in very high numbers of many hundreds to thousands of trees per acre. The increased density contributes to fire hazard and increases the likelihood of epidemic levels of insect infestation and/or disease mortality. Also, because these species are shade tolerant, their lower limbs are slow to die off and remain on the tree much longer than shade intolerant species which would create an increased ladder fuel hazard. Mature and old forest conditions would continue development at a slow pace and be at risk of increased rates of mortality (Ritchie et al. 2008, Davis et al. 2007).

Over 40 years, canopy cover would increase, BA would increase, and TPA would decrease. Closed crown canopies result in decreased sunlight to the forest floor, decreased understory productivity and diversity, increased inter-tree competition, decreased tree health, growth and vigor, increased insect and disease-related mortality especially in older age classes, and decreased horizontal heterogeneity. Regeneration would comprise mostly of white fir and Douglas-fir. Early seral species aspen and ponderosa pines would continue to be shaded out by more shade tolerant white fir and Douglas-fir. The number of medium and large-sized snags would increase overtime due to competition-induced mortality.

Mixed Conifer – Mormon Mountain

The current stand conditions are shown in Table 73. Stand conditions under the No Action Alternative for 20 and 40 years from now are shown in Table 74 and
Table 75. Current conditions show that the majority of mixed conifer stands have high BA ranging from 140 to 153 ft^2, which means that canopy cover is also high. All treatment areas have very high numbers of TPA, ranging from 868 to 888. All these factors contribute to most of the mixed conifer areas being in the upper end of the high or lower end of extreme range of density of percent max SDI. The majority of the mixed conifer stands are uneven-aged with trees in all size classes.

Under the No Action Alternative, ponderosa pine, Gambel oak and aspen would not be able to regenerate in the current closed canopy conditions and would slowly die out of the stands. In the absence of disturbance or fires, white fir and Douglas-fir would continue to increase and eventually dominate the overstory. In the absence of fire, shade tolerant species such as white fir and (to a lesser extent) Douglas-fir would continue to regenerate in very high numbers of many hundreds to thousands of trees per acre. The increased density contributes to fire hazard and increases the likelihood of epidemic levels of insect infestation and/or disease mortality. Also, because these species are shade tolerant, their lower limbs are slow to die off and remain on the tree much longer than shade intolerant species which would create an increased ladder fuel hazard. Mature and old forest conditions would continue development at a slow pace and be at risk of increased rates of mortality (Ritchie et al. 2008, Davis et al. 2007).

Over 40 years, canopy cover would increase, BA would increase, and TPA would decrease. Closed crown canopies would result in decreased sunlight to the forest floor, decreased understory productivity and diversity, increased inter-tree competition, decreased tree health, growth and vigor, increased insect and disease-related mortality (especially in older age classes), and decreased horizontal heterogeneity. Regeneration would be comprised mostly of white fir and Douglas-fir. Early seral species aspen, ponderosa pine and Gambel oak would continue to be shaded out by more shade tolerant white firs and Douglas-firs. The number of medium and large-sized snags would increase overtime due to competition-induced mortality.

Mexican Spotted Owl Habitat – Dry Lake Hills

This section contains an analysis of the entire MSO habitat in the DLH area, including ponderosa pine as well as dry mixed conifer. All of the different treatments that occur within the four different MSO habitat stratas (MSO PACs, nest cores, recovery habitat, and nest roost recovery habitat) were combined to show the overall effects the treatments would have to MSO habitat.

Table 94, Table 95 and Table 96 display the value of the stands with in the MSO PACS and recovery habitat outside of the MSO PACs along with post treatment data and stand conditions for all alternatives projected out 20 and 40 years.

Under the No Action Alternative, forest conditions within the protected and restricted stands would remain much as they are now. Currently in the pine-oak, large oaks are being over-topped by pine and shaded out and as a result have small crown ratios and have limited acorn production. In the dry mixed conifer, aspen are being shaded out by the more shade tolerant conifers. In 40 years, canopy cover would increase, basal areas would increase, and trees per acres would decrease. Closed crown canopies would result in decreased sunlight to the forest floor, decreased understory productivity and diversity, increased inter-tree competition, decreased tree health, growth and vigor, increased insect and disease-related mortality especially in older age classes, decreased understory productivity and diversity, and decreased horizontal heterogeneity. Oaks and aspen would continue to decline with little opportunity to regenerate, reducing the stand biodiversity and spatial heterogeneity.

Mexican Spotted Owl Habitat – Mormon Mountain

This section analyzes the entire MSO habitat in the MM area, and includes ponderosa pine as well as dry and wet mixed conifer. All of the different treatments that occur within the four different MSO habitat stratas (MSO PACs, nest cores, recovery habitat, and nest roost recovery habitat) were combined to show the overall effects the treatments would have to MSO habitat.

Table 73 through

Table 75 display the values of the stands within the MSO PACS and recovery habitat, along with post-treatment data and stand conditions for all alternatives projected out 20 and 40 years.

Under the No Action Alternative, forest conditions within the protected and restricted stands would remain much as they are now. Currently in the pine-oak, large oaks are being over-topped by pine and shaded out, and as a result have small crown ratios and limited mast production. In the dry mixed conifer and wet mixed conifer, the more shade-tolerant conifers are also shading out the aspen.

In 40 years, canopy cover would increase, BA would increase, and TPA would decrease. Closed crown canopies would result in decreased sunlight to the forest floor, decreased understory productivity and diversity, increased inter-tree competition, decreased tree health, growth and vigor, increased insect and disease-related mortality especially in older age classes, and decreased horizontal heterogeneity. Oaks and aspen would continue to decline with little opportunity to regenerate.

In the area proposed for MSO Nest Roost Recovery Habitat Mechanical thinning, under the No Action alternative, in 20 years basal area would be 182 ft^2 and the average number of trees greater than 18 inches dbh would be 43 TPA. The percent BA from 12 to 18 inches dbh would be 21 percent for the No Action, while the percent BA in trees greater than 18 inches dbh would be 68 percent. After 40 years, BA would be 190ft^2 and the average number of trees greater than 18 inches dbh per acres would be 40. The percent BA from 12 to 18 inches dbh would be 21 percent, while the percent BA in trees greater than 18 inches dbh would be 68 percent.

In the area proposed for MSO Nest Roost Recovery Hand thinning, in 20 years BA would be 173ft^2 and the approximate number of trees greater than 18 inches dbh per acre would be 8 for the No Action Alternative. The percent BA from 12 to 18 inches dbh would be 29 percent while the percent BA in trees greater than 18 inches dbh would be 12 percent. After 40 years, BA would be 200 ft^2 and the average number of trees greater than 18" dbh per acre would be 19. In 40 years, BA would be 200ft^2 and the average number of trees greater than 18 inches dbh per acre would be 19 for the No Action Alternative.

Grasslands

The No Action Alternative would indirectly affect grasslands within the project area. Over a minimum period of 40 years, grasslands would continue to experience pine and mixed conifer encroachment. As conifer density increases over time, grasslands would experience decreased productivity and diversity and loss of functionality in terms of hydrology, biodiversity, horizontal heterogeneity, and wildlife habitat diversity.

Aspen

Under the No Action Alternative, forest conditions within these stands would continue to decline and would not be able to successfully regenerate. Table 88 displays existing conditions within the aspen cover type in the DLH area. Over 40 years (assuming no other dramatic aspen die-off occurs), basal areas of both aspen and conifer species would increase, and TPA would decrease. The basal area increase of the conifer trees would be greater than aspen and would result in a greater rate of decline for aspen trees per acre (Figure 56). Increased canopies of conifer species would compete with and shade out the shade-intolerant aspen crowns. Closed crown canopies would result in decreased sunlight to the forest floor, decreased understory productivity and diversity, increased inter-tree competition, decreased tree health, growth and vigor, increased insect and disease-related mortality especially in older age classes, and decreased horizontal heterogeneity (Zegler et al. 2012, Calder et al. 2011).

Figure 56: Conifer encroaching an aspen stand in the DLH (2013)

Old Growth

Under the No Action Alternative, stands would continue to develop at a slower pace and may eventually meet the criteria for old growth under the current Forest Plan unless destroyed via wildfire, insects or disease. Current and increasing stand densities would continue to decrease the vigor and health of the stands. Due to high density and ladder fuel, fire hazard would increase over time. Without treatment the rate of mortality of existing yellow pines would increase both as a result of insects and disease as well as a result of combined inter-tree competition and drought (Ritchie et al. 2008, Das et al. 2011). In the event of a high severity wildfire, which is more likely under the current conditions than the treated conditions, the old ponderosa pines are more prone to dying than younger ponderosa pines (Kolb 2007).

Forest Health

Under the No Action Alternative, there would be no direct effect on dwarf mistletoe infection because no trees would be harvested. There would be no change in the level of dwarf mistletoe infection from existing levels. However, the No Action Alternative would indirectly affect the level of dwarf mistletoe infection over the long term. Under the No Action Alternative, dwarf mistletoe infection would continue to spread to more trees throughout and adjacent to infected stands, expanding at a rate of 1-2 feet per year. Increased dwarf mistletoe infection would result in reduced tree growth, reduced tree vigor, branch deformations, and shortened life span of the infected host (Conklin 2000). Reduced tree vigor and altered pitch flow associated with dwarf mistletoe infection would result in compromise of a tree’s defense mechanisms to combat bark beetle attack, thus increasing the risk of successful bark beetle attack and mortality. Reduced tree growth and shortened life span would result in stagnation of VSS classes. Additionally, the accumulation of resin and branch deformations associated with dwarf mistletoe infection would result in increased fire hazard (Conklin, 2010, Hoffman et al. 2007).

Under the No Action Alternative, increasing stand densities would result in increased inter-tree competition and decreased tree vigor. Natural defense mechanisms against insect attack, such as the production of pitch, would be limited, resulting in increased susceptibility to successful bark beetle attack and mortality. As stand densities continue to increase over time, trees become stressed, thus increasing the probability of successful bark beetle attack within the project area and further increasing the risk of bark beetle attack to all surrounding trees (McMillin 2008).

Cumulative Effects

Past Activities

According to the Coconino National Forest's historic initial entry timber atlas, the areas within the project north of Schultz Pass Road (FR420) were designated as part of a watershed protection area for the City of Flagstaff in the early 1900s. That designation along with limited access and steep slopes in the Dry Lake Hills and Mount Elden means that limited if any logging has occurred in the areas of mixed conifer forest. In the MM area there was a logging railroad spur to the top of the mountain. Logging of the pine and mixed conifer occurred on the less steep portions of the mountain. On the steeper slopes of the mountain (above approximately 35 percent slope) it does not appear that logging occurred in the mixed conifer or ponderosa pine.

Around the turn of the century and in the early 1900s, high-grade timber harvesting was conducted within the project area mainly along the foot slopes and more easily accessible. Portions of the project area were logged again during the 1940s, '70s and '80s. Additionally, pre-commercial thinning took place in the '60s and '70s.

From the late 1990s to the mid-2000s, there was a severe region-wide drought, with the year 2002 being one of extreme heat and dryness. Monitoring showed an increase of tree mortality in ponderosa pine and mixed conifer forests. The results showed that the proportion of trees dying was greatest in large trees, particularly in mixed conifer. The level of mortality was greatest in the aspen and white fir species. In mixed-conifer forests, mortality in the largest size class (greater than 28 inches dbh) exceeded 22 percent from 2002 to 2007. (Gainey & Vojta 2011)

Fire has been excluded and/or suppressed from the project area for over 110 years. From the 1970s to present, wildfires have occurred on approximately 500 acres within the DLH area and on only three acres in the MM area in the last 20 years. Reforestation efforts in the early 1980s occurred after the Radio Fire (1977) on top of Mt. Elden but largely failed and as a result, the area is still in a grass/forb development stage.

Cumulative Effects – Alternative 1: No Action:

The cumulative effects of No Action are show in Table 71 through Table 84Table 72. The tables show a trend of reduced spatial heterogeneity, mortality of larger trees (especially aspen) and loss of high-elevation grasslands that would perpetuate. Canopy cover would remain high and or increase, thus further reducing understory biodiversity and production. Inter and intra species competition for limited space, water, and sunlight would continue and increase. Aspen would continue to decline from competition and shade induced mortality. Increasing density would make existing pine trees more susceptible to bark beetle attacks with mortality occurring at a higher rate. Mixed conifer stands would continue to retain high density and the more shade tolerant species which are less fire resilient will continue to encroach upon and shade out the fire adapted and less shade tolerant ponderosa pine within those stands. Existing high fire hazards would continue and increase the potential for an unnatural stand replacing fire to occur. Conifer encroachment would continue in the meadows and grasslands. Increasing density and canopy cover would also decrease understory species diversity of grass, forbs, and shrubs.

Climate change would continue to interact with the effects of fire suppression and increased tree densities to cumulatively increase the likelihood and severity of wildfires (Westerling et al. 2006). Those areas not affected by wildfire are likely to be more susceptible to bark beetle infestation resulting from the cumulative impact of a century of fire suppression and changing climatic conditions. Large tree recruitment would become more limiting over time as climate change imposes chronic drought and more widespread tree mortality (Diggins et al. 2010, Seager et al. 2010, Van Mantgem et al. 2009, Williams et al. 2012)

Currently, there are two ongoing projects located adjacent and or inside the project area. The purpose of the Eastside and Jack Smith Schultz projects is to reduce hazardous fuel accumulation, while improving forest health and promoting the development of VSS distributions recommended by management recommendations for the northern goshawk. One other project adjacent to the DLH project area has recently been completed. The Fort Valley project was a large scale restoration treatment to reduce hazardous fuel accumulation, while improving forest health. One other project currently underway is the 4-FRI. 4-FRI is a very large landscape project that would treat the majority of the operable ponderosa pine forest across the entire district over the course of approximately 20 years. The treatments proposed for the 4-FRI project will likely be somewhat similar but more open compared to the proposed FWPP treatments and aforementioned projects. Cumulatively, these projects would have an effect of increasing forest health and resiliency at the watershed-level.

The recently-signed decision on the Coconino Travel Management Rule (September 2011) closes a number of roads within the DLH and MM project areas. We can expect the restricted travel will reduce the amount of snags and down wood removed for fuelwood harvest. (Wisdom, 2008). This would partially counteract the effects of the proposed action that include a reduction in downed woody material over the next decade as the thinning and prescribed fire treatments would be implemented.

Alternative 2 and 3

Direct & Indirect Effects

Effects common to all proposed actions

All of the treatments described below would have a prescribed broadcast burn applied after vegetation treatments are completed. Burning of dead and down fuels would release nutrients and create small patches of mineral soil, which would facilitate future regeneration. According to the fire and fuels effects results in the FVS modeling, after vegetation treatment, prescribed burns would cause approximately 3 percent reduction in stand density of max SDI. The mortality caused by prescribed fire is random and unpredictable in terms of identifying which trees would be killed by the burn. However overall mortality is greatly reduced compared to a prescribed burn applied to the No Action Alternative.

Treatments that would be the same under all three action alternatives and thus where effects would be the same are noted. Otherwise, effects discussed in this section pertain to only Alternatives 2 and 3.

Ponderosa Pine – Dry Lake Hills (Northern Goshawk)

This section includes ponderosa pine in northern goshawk habitat and in MSO areas. All three levels of analysis show that the goshawk habitat area is dominated by VSS 3 and 4 structural stages. VSS 1, 2, and 5 are lacking. At the point level LOPFA and PFA appear to have adequate representation of VSS 6, however at the stand level, LOPFA areas are lacking in VSS 6 while PFAs are over represented in VSS 6. Then at the large scale, it show that VSS 1, 2, 5, and 6 are lacking across the ponderosa pine vegetation. There is a need to create openings to introduce new VSS 1 and 2 areas. There is also a need to thin the VSS 3 and 4 stands to promote the growth of larger trees and to reduce large tree mortality (Ritchie et al. 2008).

The treatments proposed under Alternatives 2 and 3 would create openings to begin the process of creating an uneven-aged stand structure with vertical diversity (except in the nest stands) by reducing the amount of VSS 3 and 4 and increasing the amount of VSS 1 and 2. The remaining areas outside of the regeneration openings would be thinned into groups creating horizontal diversity. Thinning would also have the effect of promoting the growth of large trees, reducing the potential large tree mortality caused by inter-tree competition, and increasing the development of VSS 5 and 6 size classes in the near future (Ritchie et al. 2008, Davis et al. 2007). The proposed initial entry burn would happen approximately two years after vegetation treatment. The post treatment conditions listed in Table 70are immediately after vegetation treatment and before the initial prescribed burn.

Current habitat variables such as basal area, canopy cover, and trees per acre, SDI, and snags are similar between LOPFA and PFA treatment areas, with the nest areas having a slightly higher BA, CC, and SDI, but fewer TPA and large snags. Canopy cover is measured across the stand and includes openings within the stand, CC values range from 69 to 72 percent. Basal area ranges from 132 to 146 ft^2 and TPA (trees per acre) range from 256 to 391 trees. The percent of max SDI is at the high end of High density and low end of Extreme density.

Table 67 includes post-treatment conditions at the stand level for the LOPFA, PFA, and nest areas, and shows some changes in VSS classes from Alternatives 2 and 3. For example, within the LOPFA areas, the percent of VSS 5 increases from 8 percent before treatment to 22 percent after treatment, while the percent of VSS 3 decreases from 32 percent to 1 percent. This is the result of thinning stands that are dominated by VSS 3 or VSS 4 sized trees (5-18 inches dbh), but which also have a fair amount of VSS5 size trees (18 – 24 inches dbh). In these stands, many VSS 3 and 4 trees are being removed while almost no VSS 5 trees are removed. As a result, the percent of basal area from VSS 3 trees no longer dominates the stand, and the basal area from VSS 5 trees is greater than the basal area of other VSS classes. Again in Table 67 under the PFA, there is an increase in VSS 5 and 6 and decrease in VSS 3 and 4. Reasons for these changes are that these stands are dominated by a mix of VSS3 and VSS4 (5 – 18 inch dbh) trees. Typically the VSS 5 and 6 trees are dominate and co-dominate trees while the VSS 3 and 4 trees are co-dominate, intermediate, and suppressed trees.

In order to move toward the desired conditions for increasing the amount of VSS 5 trees and openings, it is necessary to remove those in greatest abundance, which includes VSS 3 and 4 trees. As a result, a large number of stands in the PFA would shift from VSS 3 and 4 to VSS 5 and 6. That is not to say all VSS 3 sized trees would be cut; rather, a group comprised of dominate VSS 3 trees would still be a VSS 3 group after thinning. However at the stand level the VSS class would still be classified as a VSS 5 or 6. Over time, after this treatment, the openings to create VSS 1 groups would become VSS 2 and then VSS 3 tree groups, and in future treatments, new openings would be created in those areas with an overabundance of VSS5 and 6 tree groups.

Converting the even-age stands to uneven-aged stands within this project area would take several treatments, the implementation of which would span over many decades. Post-treatment values of SDI for LOPFA is low density, while the PFA and nest stands would have an SDI value at the low end of moderate density.

One of the main treatment differences between Alternatives 2 and 3 is the harvest methods. In Alternative 2 there would be 252 acres of cable thinning (out of 1865 total acres) in LOPFA and 60 acres (out of 178 total acres) in PFA, and in Alternative 3 there would be helicopter harvesting in 242 acres (out of 1865 acres) of LOPFA and 39 acres (out of 178 acres) of PFA. Both of these harvest methods require the falling of all snags for operational safety. Effects of snag removal are discussed in the Wildlife section of this chapter.

In Alternative 3 there would be 21 acres of steep slopes in the Goshawk PFA and 10 acres in Ponderosa Pine Fuels Reduction treated using specialized steep slope harvesting machines. While the steep slope harvesting machines are similar to ground based equipment, they are not as maneuverable on steep slopes as they are on flatter ground. The limited maneuverability may require the removal of snags, oaks, or trees over 18 inches dbh only when necessary for the machine to operate safely. However the removal of these forest components is anticipated to be negligible and would not impact the ability of those areas to meet desired conditions. Unlike cable or helicopter harvest methods, ground-based thinning operations do not require the falling of snags for safety reasons due to the enclosed cabs of the machines protecting the operators. When the cable treatments and helicopter treatments are averaged in with all the ground based treatment, there is only a very slight reduction in overall snag density across all those treatment acres (e.g. at the project level).

Table 67 through Table 69 include the DLH treatment three-scale analysis for goshawk habitat and also the ponderosa pine fuels reduction MSO habitat fuels reduction treatments. Table 70 through Table 72 show the habitat values for current conditions, post treatment conditions, and values projected out 20 years and 40 years. Values for VSS 1 & 2 have been combined into a single column.

In 20 years, areas treated under Alternatives 2 and 3 would have greater increase in the percent of VSS 1, 5, and 6 tree groups versus the No Action, thus moving conditions toward desired conditions for vegetation structural stages. Openings created in the LOPFA and PFA treatments stands would have regenerated moving those stands towards the desired condition of uneven aged stand structure. The more open stand structure would increase overall tree growth among the remaining trees by reducing inter-tree competition and increasing the availability of moisture, nutrients, and sunlight. The treated stand in the goshawk nest treatments would have moved towards desired VSS by moving VSS 3 and 4 trees into a VSS5 classification more rapidly. The SDI values for the treated stands would still be in the Low to Moderate density ranges, whereas in the no action the density would be in the Extreme range. The average canopy cover for the nest stand would be lowered to 53 percent which is lower than the recommended 60 percent for goshawk nest stands. This is because the entire stand is not entirely made up of VSS 5 and 6 tree groups. There are tree groups of VSS 1, 3, and 4 which would be managed at a lower canopy cover to allow for those tree groups to more quickly grow into the desired VSS 5 and 6 size class. After 20 years there is no discernable difference in the number of snags between Alternatives 2 and 3.

In 40 years the majority of the LOPFA and PFA stand would be in the VSS 5 and 6 classifications. The openings created during treatment implementation would now be fully occupied by regeneration and moving into the VSS 3 classification. After 40 years the Goshawk nest stands would be comprised of mostly VSS 5 and 6 tree groups and canopy cover would be at 61 percent.

Approximately 150 acres of hand thinning would occur in ponderosa pine in goshawk habitat. Data for this treatment is not displayed in the tables below as there was no stand exam data available from the proposed treatment areas to input into the modeling effort. Field visits to these areas determined that desired conditions could be met or nearly met by using hand thinning methods. Compared to the other pine treatment areas, the hand thinning treatment areas are either less dense and or have smaller average size trees.   Most of the hand thinning areas are located on steep rocky south facing slopes with poorer site conditions. These stands with poor site conditions are often the first to be attacked by bark beetles in time of drought (North, 2012). The dominate VSS class is VSS 3, BA range from 60-120 ft^2. Treatments would only thin trees up to 9 inches dbh. Where practical and feasible leave trees would be arranged in groups and clumps, small openings would be created for regeneration. Tree per acre would be reduced up to 75 percent, and basal area would be reduced up to 35 percent. The thinning would have the effect of reducing the bark beetle hazard through reduced competition stress (Hayes et al. 2009).

Table 67: Dry Lake Hills - Small scale analysis of current conditions using data analyzed at the plot level and broken out into nest, PFA, and LOPFA areas. Average values calculated at the point level using individual stand exam plot data.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18"	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
LOPFA Areas	2015	115	66	261	43	4.4	2	12	10%	27%	29%	14%	20%
PFA Areas	178	137	70	321	50	3.9	1.5	12	8%	44%	19%	11%	18%
Nest Areas	45	139	71	259	55	3.2	.2	12	0%	25%	50%	13%	13%

Table 68: Dry Lake Hills - Mid-scale analysis of current stand condition using data analyzed at the stand level and broken out into nest, PFA and LOPFA areas. Average values calculated by stand broken out by LOPFA, PFA, Nest areas, MSO PAC treatments and MSO PAC Nest Burn Only treatments.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18"	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
LOPFA Areas													
Alt 1, 2, & 3	2015	132	69	314	54%	2.1	1.2	14	0%	32%	53%	8%	7%
Alt 4	1486	134	70	391	57	1.9	1	11	0%	35%	55%	10%	0%
PFA Areas													
Alt 1, 2, & 3	178	138	70	307	54%	4.2	1.4	18	0%	51%	25%	0%	24%
Alt 4	105	137	70	355	54	5.4	1.8	21	0%	22%	39%	0%	39%
Goshawk Nest													
Alts 1, 2, 3, & 4	45	146	72	256	59%	4	.3	14	0%	0%	100%	0%	0%
MSO PAC treatments													
Alts 1, 2 & 3	379	130	69	92	43	10.1	5.5	22					

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
Alt 4	230	130	69	285	51	3.4	2.4	13					
MSO PAC Nest – Burn Only													
Alts 1, 2, 3, & 4	97	55	47	73	18	2.7	1.7	8					

Table 69: Dry Lake Hills - Large scale analysis of current conditions across all goshawk areas treated within the DLH Area. Stand values averaged across all ponderosa pine stands within the northern goshawk habitat.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
All Goshawk Treated Acres	2238	133	69	312	54	2.3	1.2	14	0%	34%	51%	6%	9%

Table 70: Dry Lake Hills - Stand values of post vegetation treatment conditions (2013).

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
LOPFA Areas													
Alt 2	1865	48	43	138	19%	1.7	1.0	8	20%	1%	30%	22%	27%
Alt 3	1865	47	43	134	19%	1.7	1.1	8	20%	1%	30%	22%	27%
Alt 4	1486	43	41	177	19%	1.8	1	7	20%	2%	41%	27%	10%
PFA Areas													
Alt 2	178	73	54	99	26%	2.8	1.0	11	20%	0%	25%	11%	44%
Alt 3	178	69	52	98	25%	3.3	1.1	11	20%	0%	20%	11%	49%
Alt 4	105	74	54	106	26%	5.2	1.8	14	20%	0%	0%	18%	62%
Nest Areas													
Alts 2, 3, & 4	45	71	53	71	26%	3.9	.3	11	0%	0%	100%	0%	0%

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
MSO PAC treatments													
Alts 2	379	106	64	46	32%	8.9	5.0	23					
Alts 3	379	108	64	46	32%	10.1	5.5	24					
Alt 4	230	78	56	71	26%	3.5	2.4	13					
MSO PAC Nest – Burn Only*													
Alts 2 & 3	97	43	40	35	13%	10.5	2.2	8					

*Burn only treatments are modeled in 2016

Table 71: Dry Lake Hills - Average stand values of the no action and action alternatives projected 20 years out (2033).

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
LOPFA Areas													
Alt 1	2015	153	73	283	59%	4.2	1.4	23	0%	2%	67%	24%	7%
Alt 2	1865	54	46	105	21%	2.2	1.2	10	20%	0%	3%	43%	33%
Alt 3	1865	53	46	104	21%	2.3	1.2	10	20%	0%	3%	43%	34%
Alt 4	1486	46	43	128	19%	2.2	1	9	20%	0%	4%	58%	18%
PFA Areas													
Alt 1	178	152	73	271	55%	8.7	2.2	21	0%	9%	42%	49%	0%
Alt 2	178	67	52	97	25%	1.8	1.0	13	20%	0%	25%	0%	55%
Alt 3	178	66	52	96	24%	1.8	1.0	13	20%	0%	18%	7%	55%
Alt 4	105	81	57	87	27%	4.5	2.1	16	20%	0%	0%	0%	80%
Nest Areas													
Alt 1	45	164	74	210	62%	7.9	1	23	0%	0%	100%	0%	0%
Alts 2, 3, & 4	45	82	58	115	32%	4.4	1.2	24	0%	0%	0%	100%	0%

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
MSO PAC treatments													
Alt 1	379	118	66	71	38%	11.1	5.5	21					
Alts 2	379	97	61	80	32%	8.3	5.4	23					
Alt 3	379	98	61	80	33%	8.7	5.7	23					
Alt 4	230	81	57	156	30%	6.3	2.6	14					
MSO PAC Nest –Burn Only													
Alts 1 & 4	97	59	49	57	18%	4.6	2.4	13					
Alts 2 & 3	97	43	41	28	12%	7.6	2.6	10					

Table 72: Dry Lake Hills - Average stand values of the no action and action alternatives projected 40 years out (2053).

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
LOPFA Areas													
Alt 1	2015	165	75	253	60%	4.2	2	29	0%	0%	50%	38%	12%
Alt 2	1865	77	55	103	27%	2.1	1.1	15	0%	20%	1%	38%	40%
Alt 3	1865	76	55	102	27%	2.2	1.1	15	0%	20%	1%	38%	40%
Alt 4	1486	60	49	119	23%	1.5	.7	12	0%	20%	2%	51%	27%
PFA Areas													
Alt 1	178	160	74	234	54%	11.8	3	23	0%	0%	51%	0%	49%
Alt 2	178	87	58	70	29%	5.3	1.9	18	0%	20%	4%	21%	55%
Alt 3	178	84	57	69	27%	5.3	2.4	18	0%	20%	0%	17%	63%
Alt 4	105	91	60	76	29%	4.6	2.2	19	0%	20%	0%	0%	80%
Nest Areas													
Alt 1	45	167	75	160	59%	12	2.8	35	0%	0%	0%	100%	0%
Alts 2, 3, & 4	45	96	61	103	35%	4.5	2.6	26	0%	0%	0%	100%	0%

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	VSS 1/2 %	VSS 3 %	VSS 4 %	VSS 5 %	VSS 6 %
MSO PAC treatments													
Alt 1	379	105	63	54	32%	10.6	5.9	22					
Alts 2	379	91	59	68	29%	7.1	5.4	22					
Alts 3	379	92	60	68	30%	7.3	5.5	22					
Alt 4	230	92	60	145	33%	4.9	2.3	22					
MSO PAC Nest –Burn Only													
Alts 1	97	60	49	43	17%	6.1	2.8	15					
Alts 2 & 3	97	42	40	21	11%	5.5	2.8	12					

Ponderosa Pine – Dry Lake Hills (MSO)

The effect of treatment on MSO PAC Fuels Reduction areas reduces the BA from 130 to 106 ft² for Alternative 2 and to 108 ft² for Alternative 3. Under both Alternatives, canopy cover is reduced from 69 to 64, trees per acre are reduced from 92 to 46, and percent max SDI is reduced from 43 percent (high density) to 32 percent (moderate density). One of the differences between the alternatives is harvest methods. In Alternative 2 there would be 44 acres (out of 379) treated by cable yarding, which would require the cutting of all snags and removal of all trees (including those over 18 inches dbh) within the cable corridors. In Alternative 3, there would be 16 acres of helicopter logging within MSO PACs, which would require the removal of all snags for operational safety. After treatment there would be slightly less large snags per acre under Alternative 2 compared to Alternative 3: 5 snags per acre versus 5.5. Due to the treatment area having a relatively high number of trees greater than 18 inches dbh that would not be cut, the post-treatment stand conditions would continue to be relatively dense. The percent max SDI would continue to be in the extreme range. Competition induced mortality would continue to occur, the bark beetle hazard would be high and competition induced stress may cause the trees in this treatment area to be less resistant to insects and diseases.

In 20 years, BA, canopy cover, SDI, are all lower than the No Action Alternative. The number of large snags is about the same as current conditions, and there are slightly more large trees in Alternatives 2 and 3 than in the No Action due to increased growth rates from educed competition, which would also cause those large trees to be more resistant to mortality from competition, drought, insects and disease.

In 40 years, BA, canopy cover, and SDI are all still slightly lower than the No Action Alternative; however the number of snags and large trees are about the same. The treatment has the effect of reducing long-term mistletoe infection rating, thus improving the health and resiliency of the stands several decades after treatment.

Approximately 94 acres of hand thinning would occur within PACs. Data for this treatment is not displayed as there was no stand exam data available from the proposed treatment areas. Field visits to these areas determined that desired conditions could be met or nearly met by using hand thinning methods. Compared to the other pine treatment areas, the hand thinning treatment areas are either less dense and or have smaller average size trees. Most of the hand thinning areas are located on steep rocky south facing slopes with poorer site conditions. These stands with poor site conditions are often the first to be attacked by bark beetles in time of drought. The dominate VSS class is VSS 3, BA range from 60-120 ft². Treatments would only thin trees up to 9 inches dbh. Where practical and feasible leave trees would be arranged in groups and clumps, small openings would be created for regeneration. Tree per acre would be reduced up to 75 percent, and basal area would be reduced up to 35 percent or approximately 50 ft² BA (40 percent canopy cover). The thinning would have the effect of reducing the bark beetle hazard through reduced competition stress (Hayes et al. 2009).

Prescribed burns would be conducted in all MSO nest cores with low intensity with the purpose of reducing dead and down fuel loading, creating some mortality of smaller trees in the denser patches and raising canopy base heights. Prescribed burning would create a short term spike of smaller sized snags. Small opening may be created where the prescribed burn created pockets of mortality. The small openings would allow for trees to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. Any small openings created would also have the effect of increasing understory production and diversity.

Ponderosa Pine – Mormon Mountain (MSO)

As shown in Table 73, under all action alternatives, BA in ponderosa pine would be reduced from 161 to 60 ft², canopy cover would fall from 74 percent to 49 percent, TPA would be reduced to 534 from 730, and percent max SDI would fall from 74 percent to 31 percent in the Ponderosa Pine Fuels Reduction treatment area. This overall reduction in density along with creating 10 percent openings across each stand would have the effect of opening up the forest floor to sunlight and increasing understory diversity. The open stand conditions would allow for prescribed fire to be reintroduced in a safe and controlled manner. Competition between trees for space, water, and sunlight would be greatly reduced, increasing individual tree health and growth. Levels of dwarf mistletoe rating would be reduced through selective cutting of infected trees. The creation of regeneration openings would allow for groups of regeneration throughout the stand and create desired vertical diversity. The treatments would also leave trees in groups and clumps which would also create horizontal diversity. Small to medium size ponderosa pines would be removed from around large oaks and have the effect of reducing competition to the oaks. Oak crowns would increase in size and volume and mast (acorn) production would increase.

The effects twenty years after treatment are shown in Table 74. Basal Area and canopy cover increase slightly from immediately post-treatment conditions; however TPA and percent max SDI have decreased due to the effects of the prescribed fire reducing the number of small Gambel oak stems. The number of snags increases but is less than the No Action Alternative due to the reduced competition between trees from the thinning and prescribed burn treatments, which increase tree health and thus results in less trees dying and becoming snags.

Table 75 shows stand conditions 40 years after treatment. Basal Area and canopy cover, TPA, and percent max SDI have all accrued a healthy increase but still continue to be significantly lower than the No Action Alternative. The regeneration openings that were created now contain young trees that are starting at add to the canopy cover. The increased percent max SDI would almost be in the high density range, where the stands would start to see marked declines in understory production, competition among trees and reduced tree growth and vigor. Despite the increased stand density, this treatment area would still be benefitting from the thinning and prescribed burning treatment after 40 years.

The effects of the MSO PAC Fuels Reduction Treatment would be very similar between the different action alternatives. Alternative 2 would have 22 acres of treatment implemented using cable harvesting. Within those 22 acres, all snags would be felled and left in place due to operation safety requirements for cable yarding. Cable yarding also requires the construction of corridors for the cables to yard out the logs to be removed. Alternative 3 would implement on those same 22 acres using specialized steep slope harvesters. While the steep slope harvesting machines are similar to ground based equipment, they are not as maneuverable on steep slopes as they are on flatter ground. The limited maneuverability may require the removal of snags, oaks, or trees over 18 inches dbh only when necessary for the machine to operate safely. However the removal of these forest components is anticipated to be negligible and would not impact the ability of those areas to meet desired conditions. Alternative 4 would not treat those 22 acres. Under all the action alternatives, the remaining acres would be treated using conventional ground based harvesting methods. Treatment intensity would remain the same across all alternatives. The overall difference between the three alternatives in this treatment area would be very small because the 22 acres that would be treated differently is a fraction of the total acres.

As shown in Table 73, in MSO PAC treatments, BA would be reduced from 161 to 63 ft^2, canopy cover would fall from 74 percent to 50 percent, TPA would be reduced to 515 from 1210, and percent max SDI would fall from 72 percent to 28 percent. This overall reduction in density along with creating 10 percent openings across each stand would have the effect of opening up the forest floor to sunlight and increasing understory diversity. The open stand conditions would allow for prescribed fire to be reintroduced in a safe and controlled manner. Levels of dwarf mistletoe rating would be reduced through selective cutting of infected trees. The creation of regeneration openings would allow for groups of regeneration throughout the stand and create desired vertical diversity. The treatments would also leave trees in groups and clumps, which would also create horizontal diversity. Small to medium size ponderosa pines would be removed from around large oaks and have the effect of reducing competition to the oaks. Oak crowns would increase in size and volume and mast (acorn) production would increase.

The effects 20 years after treatment are shown in Table 77. Basal Area and canopy cover increase slightly, however TPA and percent max SDI have decreased due to the effects of the prescribed fire reducing the number of small Gambel oak stems.

Table 78 shows stand conditions 40 years after treatment. Basal Area and canopy cover, TPA, and percent max SDI have all accrued a healthy increase but still continue to be significantly lower than the No Action Alternative. The regeneration openings created during implementation would now contain young trees that are starting to add to the canopy cover. The increased percent max SDI is still solidly in the moderate density range. Despite the increased stand density, this treatment area would benefit from the thinning and prescribed burning treatment after 40 years.

There are 52 acres of identified ponderosa pine forest with in the MSO nest cores. The prescribed burn treatment would have the effect of reducing basal area from 146 to 122 ft^2, canopy cover would be lowered from 72 percent to 67 percent. Trees per acre would drop from 600 to 325. The percent max SDI is reduced from the extreme density of 61 percent to the high density of 48 percent. The number of medium (greater than 12 inches dbh) and large (greater than 18 inches dbh) snags more than doubles after treatment. Prescribed fire would have the effect of killing approximately 275 trees (according to modeling). However prescribed fire would not reduce basal area by a correspondingly large percent because the treatment would likely kill mostly small oak trees. Most of the trees greater than 18 inches dbh are anticipated to survive prescribed burning.

After 20 years the BA, canopy cover, and percent max SDI would all have increased since the prescribed burn, but would still be appreciably lower than the No Action Alternative. However the treatment area would start to once again experience tree competition and possible competition-induced mortality.

After 40 years, the BA, canopy cover, and percent max SDI would all have increased, yet would still be lower than under the No Action Alternative. The number of trees greater than 18 inches dbh would also have greatly increased; however the anticipated increase in density means the treatment area would continue to experience tree competition and competition-induced mortality.

MSO Nest Roost Recovery Habitat – Effects Common to all Action Alternatives

The MSO Nest Roost Recovery treatment area was identified as nest roost recovery habitat as part of an earlier analysis related to the 4FRI. This stand would be treated to meet the minimum habitat requirements for MSO nest roost recovery habitat under the 2012 revised MSO Recovery Plan. Under all three action alternatives, BA would be reduced from 173 to 120 ft^2, canopy cover would be reduced from 76 to 67 percent, trees per acre would be reduced from 949 to 906, and percent max SDI would be reduced from 87 to 64 percent. The percent of BA from 12 to 18 inches dbh would increase from 17 percent to 19 percent, while the percentage of BA in trees greater than 18 inches dbh would drop from 61 percent to 49 percent. Stand density would still be very high, and competition-induced mortality would still occur after treatment. Stand exam data also shows this stand contains a high number of large trees (39 TPA over 18 inches dbh). This treatment would reduce the number of trees over 18 inches dbh to approximately 19 TPA immediately after treatments.

In twenty years, BA and canopy cover would be slightly higher; however due to prescribed burning, TPA would drop to 448 TPA, and percent max SDI would also drop to 60 percent. There would not be as many snags per acre compared to the No Action Alternative. For Alternatives 2, 3, and 4, BA would be 131ft^2 and there would be approximately 22 trees greater than 18 inches dbh per acre. The percent BA from 12 to 18 inches dbh would be 30 percent for all three action alternatives versus 21 percent for the No Action Alternative. The percent BA in trees greater than 18 inches dbh would be 57 percent for all three action alternatives versus 68 percent under the No Action Alternative. Twenty years after treatment this stand would meet all minimum desired conditions for MSO Nest Roost Recovery Habitat of at least 30 percent BA in the 12-18 inch dbh size class and 30 percent BA in trees greater than 18 inches dbh, along with 120 BA and 12 trees per acre greater than 18 inches dbh.

After 40 years, BA, canopy cover, percent max SDI, and tree over 18 inches dbh would have increased while TPA and average snags per acre would have decreased. For the action alternatives, BA would be 154 and the average number of trees greater than 18" dbh per acre would be 24. The percent BA from 12 to 18 inches dbh would be 30 percent for all three action alternatives versus 21 percent for the No Action Alternative, while the percent BA in trees greater than 18 inches dbh would be 56 percent for all three action alternatives versus 68 percent for the No Action. Forty years after treatment this stand would meet all minimum desired conditions for MSO Nest Roost Recovery Habitat of at least 30 percent BA in the 12-18 inches dbh size class and 30 percent BA in trees greater than 18 inches dbh, along with 120 BA and 12 trees greater than 18 inches dbh. After 40 years the decrease in snags would be the result of no new snags being created by disturbance agents such as fire or dwarf mistletoe. This stand does not have any recorded dwarf mistletoe.

Table 73: Mormon Mountain - Stand values of current conditions and post treatment conditions for Ponderosa Pine Fuels Reduction treatments

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18"	% BA 12-18"	% BA 18"+
Ponderosa Pine										
Alt 1	776	161	74	730	74%	4.3	0.5	16		
Alts 2, 3, & 4	776	60	49	534	31%	4.1	0.5	9		
MSO PAC treatments										
Alt 1	1083	161	74	1210	72%	4.9	0.9	12		
Alt 2	1083	63	50	515	28%	4.6	0.9	13		
Alt 3	1083	63	50	515	28%	4.7	0.9	13		
Alt 4	1061	63	50	517	28%	4.7	0.9	13		

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	% BA 12-18”	% BA 18”+
MSO PAC Nest –Burn Only*										
Alts 1 & 4	52	146	72	600	61%	4.4	.5	10		
Alts 2 & 3	52	122	67	325	48%	12.4	1.2	11		
MSO Nest Roost Recovery										
Alt 1	22	173	76	949	87%	5	1.3	39	17%	61%
Alts 2, 3, & 4	22	120	67	906	64%	4.8	1.3	19	19%	49%

*Burn only treatment modeled in 2016

Table 74: Mormon Mountain - Average stand values of no action and proposed alternatives projected 20 years out for ponderosa pine stands.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	% BA 12-18”	% BA 18”+
Ponderosa Pine										
Alt 1	776	177	77	598	76%	6.9	1.1	23		
Alts 2, 3, & 4	776	65	51	222	28%	2.1	.8	11		
MSO PAC treatments										
Alt 1	1083	180	77	901	73%	7.9	1.2	18		
Alt 2	1083	69	53	207	27%	2.5	1.4	15		
Alt 3	1083	69	53	206	27%	2.5	1.4	15		
Alt 4	1061	70	53	209	27%	2.5	1.4	15		
MSO PAC Nest –Burn Only										
Alts 1 & 4	52	165	75	500	62%	7.1	1.1	15		
Alts 2 & 3	52	137	70	295	50%	7.6	1.3	15		
MSO Nest Roost Recovery										
Alt 1	22	182	77	742	86%	7.6	2.7	43	21%	68%
Alts 2, 3, & 4	22	131	69	448	60%	3.8	1.2	22	30%	57%

Table 75: Mormon Mountain - Average stand values of no action and proposed alternatives projected 40 years out for ponderosa pine stands.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18"	% BA 12-18"	% BA 18"+
Ponderosa Pine										
Alt 1	776	184	78	506	75%	9.8	2.1	30		
Alts 2, 3, & 4	776	85	58	208	34%	2.3	1.1	14		
MSO PAC treatments										
Alt 1	1083	197	79	714	73%	9.5	2	26		
Alt 2	1083	86	58	194	31%	2.2	1.6	19		
Alt 3	1083	86	58	194	31%	2.2	1.6	19		
Alt 4	1061	87	58	195	31%	2.3	1.6	19		
MSO PAC Nest –Burn Only										
Alts 1 & 4	52	182	77	440	63%	8	1.6	26		
Alts 2 & 3	52	150	72	258	51%	7.8	1.8	27		
MSO Nest Roost Recovery										
Alt 1	22	190	78	608	86%	7.5	3	40	21%	68%
Alts 2, 3, & 4	22	154	73	410	67%	2.5	.7	24	30%	56%

Mixed Conifer – Dry Lake Hills

Common to Alternatives 2, 3 and 4

Though the Northern Goshawk Nest Fuels Reduction treatment description is slightly different from what is proposed for the rest of mixed conifer MSO recovery habitat, the desired conditions would still be in line with guidelines for MSO recovery habitat. All other northern goshawk nests are located within MSO PACs, which is why they are not discussed separately. This nest site is outside of PACs so we can treat it separately within the revised MSO Recovery Plan guidelines for recovery habitat. This treatment area would be an intermediate thin from below: basal areas would be reduced from 157 to 71. Canopy cover would decrease from 74 to 53 percent and TPA would be reduced from 931 to 204. No trees over 18 inches dbh would be cut, of which there is an average of 20 TPA. This treatment would also move the stand from an extreme density rating to a moderate density rating. Competition between trees for space, water, and sunlight would be greatly reduced, increasing individual tree health and growth. This treatment would not create any regeneration openings. There would be a response from the understory from opening up the overstory canopy, but without creating regeneration openings the increased understory productivity would be short lived as the overstory crowns grow and close in.

After 20 years, BA, canopy cover, and percent max SDI would increase, but still be substantially lower than the No Action Alternative. Also, the number of large trees would not be as great compared to the No Action Alternative. This is not because large trees would be cut; rather it is because there would be fewer middle size trees available in the more open treated conditions to grow into large trees than there would be in the dense conditions of the No Action Alternative.

After 40 years, BA, canopy cover, and percent max SDI would increase, but still be significantly lower than the No Action Alternative. The stand density would now be in the high range and the trees would start competing for resources amongst each other. After 40 years, the stand conditions would still be much more open than current conditions, showing that the positive effects of thinning and burning would last at least 40 years. The number of large trees would still not be as great compared to the No Action Alternative.

There are two identified PFAs in the DLH. Only the Schultz Pass PFA contains mixed conifer outside of MSO PACs. The action alternatives would mechanically treat mixed conifer within the Schultz Pass PFA following the Forest Plan standards and guidelines for managing northern goshawk PFAs outside of nest centers. The treatment would also follow the recommendations for treatment of MSO recovery habitat. Treatment within the Schultz PFA areas would reduce the BA from 135 to 76 ft^2 for Alternatives 2, 3 and 4; canopy cover would be reduced from 70 to 55 percent, and TPA would decrease from 850 to 115. Even though the average stand canopy cover would be 55 percent, the Forest Plan standards of maintaining 60 percent canopy cover within VSS 4-6 would still be maintained; the average is lower than 60 percent when areas of VSS 1-3 are factored in. Percent max SDI would decrease from 57 percent (extreme density) to 24 percent (low density). The trees per acre of trees larger than 18 inches dbh would decrease from 21 to 15.

Openings would be created in up to 20 percent of the treatment area. The overall reduction in density along with creating 20 percent openings across each stand would have the effect of opening up the forest floor to sunlight and increasing understory diversity. The creation of 20 percent openings would allow for early seral species such as aspen and pine to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. The open stand conditions would allow for prescribed fire to be reintroduced in a safe and controlled manner. Selective cutting of trees infected with dwarf mistletoe would help to reduce overall infection levels in the stand and improve overall stand health.

In 20 years, BA, canopy cover, TPA, percent max SDI, and trees greater than 18 inches dbh would all have increased post-treatment (Table 77). The number of trees would have increased due to regeneration in the openings. The number of large snags would have decreased slightly to 2.2 snags per acre and would only be slightly less than the 2.6 snags per acre in the No Action Alternative. The number of trees greater than 18 inches dbh would have gone up slightly but would be approximately half that of the No Action Alternative. The number of 18 inch dbh trees would be less due to the removal of some of the medium size trees from which are no longer available to grow into future large trees.

In order for the action alternatives to have the same number of large trees as the No Action Alternative would require thinning from below in order to leave all the large and medium size trees. This would also require the removal of most of the smaller trees and prevent the creation of regeneration openings thus not meeting the desired condition of creating an uneven-age heterogeneous stand structure. It would also remove all of the lower age class tress that would eventually grow into large, mature trees in the coming decades.

In 40 years, BA, canopy cover, and SDI would all still be significantly lower than the No Action Alternative (Table 78). The number of snags and large trees would be less than the No Action Alternative. Trees over 18 inches dbh would be less than the No Action Alternative: 19 TPA compared to 27 TPA due to the same issue discussed in the previous paragraph. However, it is important to note that under Alternatives 2 and 3, the large trees would have much less likelihood of mortality because they would be much more resilient to inter-tree competition, drought, insects and disease. Overall stand density is still greatly lower than current conditions, showing that thinning and burning treatments would have the positive effect of lower stand density for at least 40 years.

Specific to Alternatives 2 & 3

Treatment within Mixed Conifer Fuels Reduction areas would reduce the BA from 141 to 62 ft^2 for both Alternative 2 and 3; canopy cover would be reduced from 71 to 50 percent, and TPA would decrease from 1130 to 213 for Alternative 2 and 198 for Alternative 3. Percent max SDI would decrease from 57 percent (extreme density) to 22 and 21 percent (low density) under Alternatives 2 and 3, respectively. The creation of 10 percent openings would allow for early seral species such as aspen and pine to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics.

The main difference between Alternatives 2 and 3 is the harvest methods used. Alternative 2 would treat 514 acres (out of 1140) by cable yarding, which would require the cutting of all snags both within and immediately adjacent to cable corridors, as well as the removal of all trees (including those over 18 inches dbh) within the cable corridors. Despite the creation of the cable corridors, the average number trees over 18 inches dbh post-treatment within this treatment area would be about the same in this alternative compared to Alternative 3. Alternative 3 would include 425 acres of helicopter logging, which would require the removal of all snags in those units for operational safety.

After treatment there would be fewer large snags per acre under each alternative: 2.1 snags for Alternative 2 and 2.4 snags for Alternative 3 compared to snags per acre in the No Action Alternative. Openings would be created in up to 10 percent of the treatment area. The overall reduction in density along with creating 10 percent openings across each stand would have the effect of opening up the forest floor to sunlight and increasing understory diversity. The more open stand conditions would allow for prescribed fire to be reintroduced in a safe and controlled manner. Selective cutting of trees infected with dwarf mistletoe would help to reduce overall infection levels in the stand and improve overall stand health.

In 20 years, BA, canopy cover, SDI, would all still be about the same as post-treatment due to mortality associated with prescribed fire. The number of trees would have increased due to regeneration in the openings. The number of large snags would be about the same and is only slightly less than the No Action Alternative. The number of trees greater than 18 inches dbh would have gone up slightly but would still be less than the No Action Alternative. The number of 18 inch dbh trees would be less due to the removal of some of the medium size trees from which are no longer available to grow into future large trees. In order for the action alternatives to have the same number of large trees as the no action alternative would require thinning from below in order to leave all the large and medium size trees. This would also require the removal of most of the smaller trees and prevent the creation of regeneration openings thus not meeting the desired condition of creating an uneven-age heterogeneous stand structure.

In 40 years, BA, canopy cover, and SDI would all still be significantly lower than the No Action Alternative. The number of snags would be about the same as the No Action Alternative. Trees over 18 inches dbh would be less than the No Action Alternative: 17 TPA compared to 23 TPA due to the same issue discussed in the previous paragraph. Overall stand density is still greatly lower than current conditions, showing that thinning and burning treatments would have the positive effect of lower stand density for at least 40 years.

Field visits to the area proposed for Mixed Conifer Fuels Reduction hand-thinning treatment determined that treatment by cable yarding would not be desirable or practical due to the high cost and potential resource damage from building temporary roads through very rocky, inaccessible ground in order to access those areas. Alternative 2 would hand thin 132 acres; under Alternative 3, only 85 acres would be hand thinned in this treatment area. The reduction in the number hand thinning acres in Alternative 3 is due to more acres that could have material removed by helicopter without the anticipated resource damage associated with cable corridors. Most of the hand thinning areas would be located on steep rocky slopes with poorer site conditions.

Basal area would be reduced from 140 to 102 ft^2, canopy cover would be reduced from 71 to 63 percent, TPA would be reduced from 1248 to 275, the percent max SDI would be reduced from 59 to 35 percent.

After 20 years, basal area and canopy cover would be lower as the result of the mortality associated with prescribed burning. TPA would also be lower due to tree mortality from prescribed burning. With fewer trees, the percent max SDI would now be in the moderate density range.

After 40 years, basal area and canopy cover would have increased. The density rating would still be in the moderate range. Even after 40 years, this treatment area would still meet fuels reduction targets.

Low intensity prescribed burning would be conducted within 163 acres of MSO nest cores within the DLH with the purpose of reducing dead and down fuel loading, creating some mortality of smaller trees in the denser patches, and raising canopy base heights. Prescribed burning would create a short term spike of smaller sized snags. Small opening may be created where the prescribed burning created pockets of mortality. The small openings would allow for early seral species such as aspen and pine to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. Any small openings created would also have the effect of increasing understory production and diversity.

A district-wide assessment of available MSO nest roost recovery habitat identified a need to designate 72 acres of nest roost habitat within the mixed conifer habitat within DLH. The area designated was assessed for treatment needs; based on this assessment, a hand thinning treatment was determined to meet the objectives of reducing fire hazard while meeting the intent of the revised MSO Recovery Plan guidelines. As outlined in the description of effects below, the proposed treatment would lower the BA from 148 to 99 ft^2. This would lower the BA below the recommended threshold of 120 ft^2; however this stand has a very high number of trees per acre (2,986), of which approximately 2,600 are less than 9 inches dbh. Thinning this stand to 120 ft^2 of BA would require leaving an additional 74 trees per acre between 5 and 9 inches dbh. If that were to occur, after 40 years, there would be 16 trees per acre greater than 18 inches dbh compared to 17 trees per acre greater than 18 inches dbh under Alternatives 2 and 3. The model shows that thinning to 99 ft^2 instead of 120 ft^2 would also have greater fuels reduction benefits over 40 years, such as greater average crown base height, less crown bulk density, and greater crowning and torching indexes.

BA in the 72 acres proposed for MSO Nest Roost Recovery hand-thinning would be reduced from 148 to 99 ft^2, canopy cover would be reduced from 72 to 62 percent, TPA would be reduced from 2986 to 421, and the percent max SDI would be reduced from 71 to 34 percent.

After 20 years, BA and canopy cover would be somewhat lower due to mortality caused by prescribed burning. TPA would also be lower due to tree mortality from prescribed burning. With fewer trees, the percent max SDI would also be lower. Increased sunlight to the forest floor would increase understory production and diversity. For Alternatives 2 and 3, BA would be $78ft^2$ and the average number of trees greater than 18 inches dbh per acre would be 11. The percent BA from 12 to 18 inches dbh would be 56 percent for the two action alternatives versus 29 percent for the No Action Alternative, while the percent BA in trees greater than 18 inches dbh would be 30 percent for all three action alternatives versus 12 percent for the No Action Alternative. Twenty years after treatment this stand would not meet minimum desired conditions for MSO Nest Roost Recovery Habitat of 120 BA and 12 trees greater than 18 inches dbh.

After 40 years, basal area and canopy cover would have increased back to conditions similar to post vegetation treatment. For Alternatives 2 and 3, basal area would be $93ft^2$ and the average number of trees greater than 18 inches dbh per acre would be 17. The percent BA from 12 to 18 inches dbh would be 30 percent for the two action alternatives versus 20 percent for the No Action Alternative, while the percent BA in trees greater than 18 inches dbh would be 62 percent for the two action alternatives versus 22 percent for the No Action Alternative. Forty years after treatment this stand would meet minimum desired conditions for MSO Nest Roost Recovery Habitat of at least 30 percent BA in the 12-18 inch dbh size class and 30 percent BA in trees greater than 18 inches dbh, along with 12 TPA greater than 18 inches dbh, but would not have the minimum 120 BA. Under the No Action Alternative, the minimum habitat requirements would be met for BA and large trees but not for percentage of BA in the 12-18 inch dbh or 18 inch+ dbh size classes. The minimum habitat requirements would not quite be met in 40 years with this treatment, whereas they might be met in the No Action Alternative if no significant wildfire were to occur. However, under Alternatives 2 and 3, the stand would be much more fire resilient, tree health would be greater and more resilient to major drought events, and trees would have greater resistance to bark beetle attacks.

MSO PAC Fuels Reduction Treatment under Alternatives 2 and 3 would reduce the BA from 137 to 81 ft^2 for Alternative 2 and 82 ft^2 for Alternative 3. Canopy cover would be reduced from 70 to 57 percent, and TPA would be reduced from 1143 to 306 for Alternative 2 and 256 for Alternative 3. Percent max SDI would be reduced from 56 percent (extreme density) to 29 percent (moderate density). The creation of 10 percent openings would allow for early seral species such as aspen and pine to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics.

The primary difference between the two alternatives is harvest method utilized for material extraction. In Alternative 2 there would be 316 acres (out of 788 acres) treated by cable yarding, which would require the cutting of all snags within and adjacent to the cable corridor, and removal of all trees (including those over 18 inches dbh) within the cable corridors. In Alternative 3 there would be 251 acres (out of 816 acres) of helicopter logging, which would require the removal of all snags in those units for operational safety. After treatment there would be slightly fewer large snags per acre in Alternatives 2 and 3 than under the No Action Alternative: 2.3 and 2.7 respectively, compared to 4.0 No Action Alternative. Openings would be created in up to 10 percent of the treatment area. The overall reduction in density along with creating 10 percent openings across each stand would have the effect of opening up the forest floor to sunlight and increasing understory diversity. The open stand conditions would allow for prescribed fire to be reintroduced in a safe and controlled manner. Selective cutting of trees infected with dwarf mistletoe would help to reduce overall infection levels in the stand and improve overall stand health and promote development of VSS 3 and 4 trees to VSS 5 and 6 trees.

In 20 years, BA, canopy cover, SDI, would have increased slightly. The number of large snags and trees greater than 18 inches dbh would be slightly less than the No Action Alternative.

In 40 years, BA, canopy cover, and SDI would all be greatly lower than the No Action Alternative. The number of snags and large trees would still be slightly lower compared to the No Action Alternative. The number of 18 inch dbh trees would be less due to the removal of some of the medium size trees from which are no longer available to grow into future large trees. In order for the action alternatives to have the same number of large trees as the no action alternative would require thinning from below in order to leave all the large and medium size trees. This would also require the removal of most of the smaller trees and prevent the creation of regeneration openings thus not meeting the desired condition of creating an uneven-age heterogeneous stand structure. Thinning from below would also create an age class “gap” so that in several decades there would be few or no trees available to replace the large mature trees that die off. Because the treatments would reduce recruitment of future large trees in the coming decades and stand conditions would be more open, there would be slightly fewer large trees available to become snags and the large trees available would have less competitive stress, thus would be healthier and would be less likely to die and become snags.

Table 76: Dry Lake Hills - Stand values of current conditions and post treatment conditions for Dry Mixed Conifer

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	% BA 12-18”	% BA 18”+
Goshawk Nest Fuels Red.										
Alt 1	54	157	74	931	72	7.4	3.3	20		
Alts 2, 3, & 4	54	71	53	204	28	7.2	3.2	20		
Goshawk PFA Fuels Red.										
Alt 1	181	135	70	850	57	6.6	2.7	21		
Alts 2, 3, & 4	181	76	55	115	24	6.4	2.6	15		
Mixed Conifer Fuels Red.										
Alts 1	1124	141	71	1130	57	9.6	4.0	13		
Alt 2	1124	62	50	213	22	5.0	2.1	12		
Alt 3	1158	62	50	198	21	5.8	2.4	12		
Alt 4	542	63	50	217	22	8.9	3.8	12		
Mixed Conifer Fuels Red. Hand Thin										
Alts 1	132	140	71	1248	59%	11	4.3	12		
Alt 2	132	102	63	275	35%	10.4	4.1	12		
Alt 3	85	102	63	275	35%	10.4	4.1	12		
MSO Nest Fuels Red. Hand Thin										
Alts 1	122	122	67	1952	54	6.2	4.3	13		
Alts 2, 3 & 4	122	111	65	540	41	5.9	4.1	13		
MSO Nest Fuels Reduction Burn Only*										
Alts 1 & 4	163	139	70	476	50	5.9	2.6	24		
Alts 2 & 3	163	108	64	174	34	16.3	6.5	21		
MSO Nest Roost Recovery Hand Thin										
Alts 1 & 4	72	148	72	2986	71	16.23	2.4	7	25%	11%
Alts 2 & 3	72	99	62	421	34	15.4	2.3	7	38%	16%

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	% BA 12-18”	% BA 18”+
MSO PAC Fuels Reduction										
Alt 1	788	137	70	1143	56	9.2	4.0	14		
Alt 2	788	81	57	306	29	5.1	2.3	14		
Alt 3	816	82	57	256	29	5.8	2.7	14		
Alt 4	337	81	57	201	27	6.9	3.8	16		
MSO PAC Fuels Reduction Hand Thin										
Alt 1	108	120	67	1067	53	7	4.1	13		
Alts 2 & 3	108	93	60	126	29	6.8	4	13		
Alt 4	121	93	60	126	29	6.8	4	13		

***Burn only treatments were modeled to occur 2016**

Table 77: Dry Lake Hills - Average stand values of no action and proposed alternatives projected 20 years for Dry Mixed Conifer

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	% BA 12-18”	% BA 18”+
Goshawk Nest Fuels Red.										
Alt 1	54	185	78	853	78	6.3	2.1	33		
Alts 2, 3, & 4	54	83	57	223	32	4.2	2.6	24		
Goshawk PFA Fuels Red.										
Alt 1	181	159	74	767	62	7.9	2.6	26		
Alts 2, 3, & 4	181	83	57	202	29	4.4	2.2	17		
Mixed Conifer Fuels Red.										
Alts 1	1124	169	75	1016	64	5.0	2.3	18		
Alt 2	1124	62	50	340	24	3.4	1.9	14		
Alt 3	1158	62	50	342	24	3.5	2.0	15		
Alt 4	542	64	50	344	24	4.3	2.7	15		
Mixed Conifer Fuels Red. Hand Thin										
Alts 1	132	171	76	1116	66%	4.8	2.4	16		
Alt 2	132	92	60	131	27	6.3	2.9	17		
Alt 3	85	92	60	131	27	6.3	2.9	17		
MSO Nest Fuels Red. Hand Thin										
Alts 1	122	184	78	1477	71	4.1	2	16		
Alts 2, 3 & 4	122	111	65	199	35	4.5	2.4	15		
MSO Nest Fuels Reduction Burn Only										
Alts 1 & 4	163	159	74	438	54	6.1	2.4	27		
Alts 2 & 3	163	118	66	201	36	9.7	4	22		
MSO Nest Roost Recovery Hand Thin										
Alts 1 & 4	72	173	76	2386	75	5.6	1.5	8	29%	12%
Alts 2 & 3	72	78	56	172	23	6	1.5	11	56%	30%
MSO PAC Fuels Reduction										
Alt 1	788	166	75	1022	63	5.4	2.4	19		
Alt 2	788	87	58	398	33	3.7	2.0	17		

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18"	% BA 12-18"	% BA 18"+
Alt 3	816	86	58	379	33	3.9	2.2	17		
Alt 4	337	88	59	324	31	4.2	2.7	17		
MSO PAC Fuels Reduction Hand Thin										
Alt 1	108	140	71	976	57	5.9	2.8	15		
Alts 2 & 3	108	85	58	75	25	6.6	3.2	14		
Alt 4	121	85	58	75	25	6.6	3.2	14		

Table 78: Dry Lake Hills - Average stand values of no action and proposed alternatives projected 40 years for Dry Mixed Conifer

	Acres	BA (FT2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18"		
Goshawk Nest Fuels Red.										
Alt 1	54	211	81	765	80	7.5	2	37		
Alts 2, 3, & 4	54	106	63	211	37	2.9	1.7	24		
Goshawk PFA Fuels Red.										
Alt 1	181	185	78	669	66	8.4	2.8	27		
Alts 2, 3, & 4	181	101	62	191	33	3.6	2	19		
Mixed Conifer Fuels Red.										
Alts 1	1124	193	79	885	68	5.1	1.8	23		
Alt 2	1124	77	56	320	27	2.0	1.5	17		
Alt 3	1158	77	55	322	27	2.0	1.5	17		
Alt 4	542	79	56	323	27	2.4	1.9	17		
Mixed Conifer Fuels Red. Hand Thin										
Alts 1	132	199	80	965	70%	3.8	1.6	23		
Alt 2	132	106	64	123	29%	3.7	2	22		
Alt 3	85	106	64	123	29%	3.7	2	22		
MSO Nest Fuels Red. Hand Thin										
Alts 1	122	225	83	939	77	6	1.5	19		
Alts 2, 3 & 4	122	142	71	183	41	3.3	1.3	20		
MSO Nest Fuels Reduction Burn Only										
Alts 1 & 4	163	178	77	395	57	6	2.7	32		
Alts 2 & 3	163	131	69	145	38	6.1	3.3	28		
MSO Nest Roost Recovery Hand Thin										
Alts 1 & 4	72	200	80	1904	79	5.1	1.2	19	20%	22%
Alts 2 & 3	72	93	60	165	26	1.6	.8	17	30%	62%
MSO PAC Fuels Reduction										
Alt 1	788	194	79	885	68	5.1	1.9	24		
Alt 2	788	109	64	372	38	2.3	1.6	19		
Alt 3	816	108	64	355	38	2.5	1.7	20		
Alt 4	337	111	65	302	37	2.9	2.1	20		
MSO PAC Fuels Reduction Hand Thin										
Alt 1	108	165	75	890	62	6.4	2.5	17		

	Acres	BA (FT2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	
Alts 2 & 3	108	91	60	66	25	6.1	2.6	17	
Alt 4	121	91	60	66	25	6.1	2.6	17	

Mixed Conifer – Mormon Mountain

Dry Mixed Conifer

Under Alternatives 2 and 3, low intensity prescribed burning would be conducted within approximately 317 acres of MSO nest cores with the purpose of reducing dead and down fuel loading, creating some mortality of smaller trees in the denser patches, and raising canopy base heights within MSO nest cores on Mormon Mountain. Prescribed burning would create a short term spike of smaller sized snags. Small openings may be created where the prescribed burning created pockets of mortality. The small openings would allow for early seral species such as aspen, pine and oak to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. Any small openings created would also have the effect of increasing understory production and diversity. Prescribed burning would have the effect of reducing BA from 140 to 116 ft². TPA would be reduced from 868 to 364, and percent max SDI would be reduced from 54 to 39 percent.

In 20 years BA is projected to be 138 ft² and canopy cover would be 70 percent, which is similar to existing conditions.

Forty years after treatment, BA would be 164 ft², canopy cover would be 75 percent and percent max SDI would be 49 percent. While BA and canopy cover would exceed today’s current condition, the percent max SDI would still be less. Thus 40 years after treatment, the stand would include more large trees as a percentage of all trees, thereby being more in line with desired conditions compared to the No Action Alternative.

MSO PAC Fuels Reduction treatments would apply to approximately 509 acres of mixed conifer stands located within the six MSO PACs within the Mormon Mountain area. Up to 509 acres would be mechanically treated. Treatments would maintain a minimum of 40 percent canopy cover; openings would be created from 0.1 to 2.5 acres in size in up to 10 percent of the treatment acres. The openings would allow for early seral species such as aspen, pine and oak to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. Treatments would be designed to maintain or create horizontal and vertical patch heterogeneity. Tree species diversity would be maintained with an emphasis on protecting large oaks and aspen by thinning out conifers which overtop the oaks and aspen. Trees over 18 inches dbh would not be cut, except for on 52 acres of proposed cable yarding in Alternative 2 where it would be necessary to cut approximately 2 trees per acre larger than 18 inches dbh for the purpose of creating the cable yarding corridors. No snags would be cut under this treatment except for safety purposes in the 52 acres of cable yarding in Alternative 2.

Table 79 displays the post treatment stand values for the proposed treatments. The proposed treatments would reduce the BA from 153 to 86 ft² for Alternative 2, 87 ft² for Alternative 3, and 88 ft² for Alternative 4. Canopy cover is reduced from 73 to 59, and trees per acre are reduced from 888 to 274 for alternative 2 and 275 for alternative 3. Percent Max SDI is reduced from 56 percent (extreme density) to 29 percent (moderate density). One of the differences between the alternatives is harvest methods. In Alternative 2 there would be 52 acres (out of 509) treated by cable yarding which would require the cutting of all snags and removal of approximately 2 trees per acre over 18 inches dbh within the cable corridors. After treatment there would be slightly fewer large snags per acre in Alternative 2 compared to Alternative 3; 7.8 versus 8.8 Openings would be created in up to 10 percent of the treatment area. The overall reduction in density along with creating 10 percent openings across each stand would have the effect of opening up the forest floor to sunlight and increasing understory diversity. The open stand conditions would allow for prescribed fire to be reintroduced in a safe and controlled manner. Selective cutting of trees infected with dwarf mistletoe would help to reduce overall infection levels in the stand and improve overall stand health. Table 80 displays the stand values for the proposed treatments projected out 20 years. In 20 years, BA, Canopy Cover, SDI, would have increased slightly. The number of large snags and trees greater than 18 inches dbh would be slightly greater than the No Action Alternative.

Table 81 displays the stand values for the proposed treatments projected out 40 years. In 40 years, BA, Canopy Cover, and SDI would all continue to be greatly lower than the no action alternative. The number of snags and large trees would still be slightly lower compared to the no action.

Table 79: Mormon Mountain - Stand values of current conditions and post treatment conditions for Dry Mixed Conifer.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
MSO Nest Fuels Reduction - Burn Only								
Alt 1	317	140	71	868	54	24.5	9.4	20
Alts 2 & 3*	317	116	66	364	39	21.8	8.3	18
MSO PAC treatments								
Alt 1	509	153	73	888	56	22.8	9.2	22
Alt 2	509	86	58	274	29	18.6	7.8	22
Alt 3	509	87	59	275	29	20.8	8.8	22
Alt 4	448	88	59	290	30	20.7	8.7	23

*Burn only treatment modeled in 2016

Table 80: Mormon Mountain - Average stand values of no action and proposed alternatives projected 20 years for Dry Mixed Conifer.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
MSO Nest Fuels Reduction - Burn Only								
Alt 1	317	174	76	805	61	3.9	2.4	24
Alts 2 & 3	317	138	70	351	44	4.4	2.6	22
MSO PAC treatments								
Alt 1	509	188	78	826	64	4.8	2.9	26
Alt 2	509	90	60	263	29	3.4	3.0	21
Alt 3	509	90	60	263	30	3.7	3.2	21
Alt 4	448	91	60	268	30	3.6	3.2	22

Table 81: Mormon Mountain - Average stand values of No Action and proposed alternatives projected 40 years for Dry Mixed Conifer.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
MSO Nest Fuels Reduction - Burn Only								
Alt 1	317	206	80	708	63	4	1.9	28
Alts 2 & 3	317	164	75	326	49	3.8	2	27
MSO PAC treatments								
Alt 1	509	219	82	747	69	5.1	2.3	29
Alt 2	509	109	65	252	34	2.3	2.0	21
Alt 3	509	110	65	252	35	2.4	2.2	22
Alt 4	448	110	65	257	35	2.3	2.1	22

Wet Mixed Conifer

Under Alternatives 2 and 3, treatments are proposed within the identified wet mix conifer cover type within the MSO nest cores on MM. No wet mixed conifer exists within the DLH. The wet mixed conifer cover type is a mixed-severity fire regime. This area may or may not be out of the historic range of variability. These treatments are being conducted so that if and when this forest does burn, it burns as a mixed severity fire and not a severe one (e.g. complete crown fire) with undesirable effects.

Low intensity prescribed burning would be conducted with the main purpose of reducing dead and down fuel loading. The purpose of the treatment would not be to put fire on every acre of ground, but rather to reduce the amount of large woody debris that have resulted from a large amount of recent mortality from drought (see Existing Conditions in Chapter 2). In areas outside of MSO nest cores where small groups of mature aspen occur from 0.25 to 2 acres in size, aspen snags and conifers would be felled by hand and jackstrawed in attempts to regenerate aspen in up to 10 percent of the stand. Aspen is an early seral species for wet mixed conifer and serves the purpose of breaking up the overstory fuel continuity. Dead and down material would be piled for burning to reduce the heavy fuel loading and allow for lower-intensity prescribed burning. Trees over 18 inches dbh would not be cut.

In Alternative 2, approximately 35 acres of wet mixed conifer would have cable corridors running through them for the purpose of accessing the dry mixed conifer stand on the slopes below. The areas between the cable corridors within the wet mixed conifer would not be thinned; however all trees and snags would be cut out of the corridors themselves. Within these 35 acres approximately 4 acres would be within the corridors.

Table 82 displays the post treatment stand values for the proposed treatments. The proposed treatments within wet mixed conifer would reduce the BA from 155 to 129 ft² for Alternative 2 and 131 ft² for Alternative 3. Canopy cover would be reduced from 73 to 69 percent, and TPA would be reduced from 1164 to 704 for Alternative 2 and 715 for Alternative 3. Percent max SDI would also be reduced from 47 percent (high density) to 39 percent and 40 percent (high density) for Alternatives 2 and 3, respectively.

One other difference between the alternatives would be the difference in residual snags due to the cable corridors on 33 acres in Alternative 2, which would result in approximately 11.0 snags per acre versus 11.2 snags per acre in Alternative 3. Regeneration openings would be created in up to 10 percent of the treatment area. The overall reduction in density along with the increase in openings across each stand would have the effect of opening up the forest floor to sunlight and increasing understory diversity. The more open stand conditions would allow for aspen to regenerate and provide both horizontal and vertical diversity throughout the stand.

Table 83 displays the stand values for the proposed treatments projected out 20 years. In 20 years, BA and canopy cover would increase, but the percent max SDI would stay the same. The number of large snags would have gone down but would still be a relatively high at four snags per acre.

Table 84 displays the stand values for the proposed treatments projected out 40 years. In 40 years, BA, canopy cover, and SDI would all increase and be more in line with desired conditions, but would still be lower than the No Action Alternative modeled out to 40 years. After 40 years BA, canopy cover, and percent max SDI would exceed or equal the current stand condition. The effectiveness of the treatment on stand density would last between 20 and 40 years. The creation of openings on up to 10 percent of the stand would have the effect of helping to maintain the uneven age conditions of the stand and promote the re-growth of declining aspen stands.

In areas proposed for burn only within MSO nest cores, small openings may be created where prescribed burning would create pockets of mortality. The small openings would allow for early seral species such as aspen, and pine to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. Any small openings created would also have the effect of increasing understory production and diversity.

The burn only treatment would have the effect of reducing BA from 155 to 132 ft². TPA would be reduced from 1164 to 475, and percent max SDI would be reduced from 47 to 37 percent.

In 20 years BA would be 160 ft² and canopy cover would be 74 percent, which would exceed the current (2013) conditions. However percent max SDI would be 42 percent, which is less than current (2013) conditions. Thus the treatments would modify stand conditions to make large trees a greater percentage of all trees in the stand and thereby improve tree resilience and move the area on a trajectory more in line with desired conditions.

Forty years after treatment, BA, canopy cover and percent max SDI would be 195, 79 percent, and 49 percent, respectively. All three of those variables would exceed the current conditions which mean the effects of the treatments would only last about 20 years before stand conditions return to or exceed current conditions.

Table 82: Mormon Mountain - Stand values of current conditions and post treatment conditions for Wet Mixed Conifer.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
MSO Nest – Burn Only*								
Alt 1 & 4	33	155	73	1164	47	25.8	12.1	13
Alts 2, & 3	33	132	69	475	37	24.1	10.6	12
MSO PAC treatments								
Alt 1 & 4	180	155	73	1164	47	25.8	12.1	13

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
Alt 2	180	129	69	704	39	21.0	11.0	12
Alt 3	180	131	69	715	40	21.4	11.2	12

*Burn only treatment modeled in 2016

Table 83: Mormon Mountain - Average stand values of no action and proposed alternatives projected 20 years for Wet Mixed Conifer.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
MSO Nest – Burn Only								
Alt 1 & 4	33	188	78	974	54	7.3	4.1	21
Alts 2, & 3	33	160	74	446	42	5.7	4.1	20
MSO PAC treatments								
Alts 1 & 4	180	188	78	974	54	7.3	4.1	21
Alt 2	180	139	71	414	39	4.9	3.9	19
Alt 3	180	141	71	409	39	5	4	19

Table 84: Mormon Mountain - Average stand values of no action and proposed alternatives projected 40 years for Wet Mixed Conifer.

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
MSO Nest – Burn Only								
Alt 1 & 4	33	218	82	769	59	6.8	3	25
Alts 2, & 3	33	195	79	403	49	4.8	2.9	23
MSO PAC treatments								
Alts 1 & 4	180	218	82	769	59	6.8	3	25
Alt 2	180	173	76	381	45	4.0	2.8	22
Alt 3	180	175	76	378	45	4.1	2.9	22

Mexican Spotted Owl Habitat– Dry Lake Hills

This section analyzes the entire MSO habitat in the DLH area, including ponderosa and dry mixed conifer. All of the different treatments that occur within the four different MSO habitat stratas (MSO PACs, nest cores, recovery habitat, and nest roost recovery habitat) were combined to show the overall effects the treatments would have to MSO habitat.

The average current condition has a BA of 133 ft², canopy cover of 69 percent, 824 TPA, and % max SDI is 52 percent. After treatment, those numbers would be reduced to: 89 ft² of BA, 59 percent canopy cover, 184 TPA, and 20 percent max SDI. The treatments would be designed to create a mosaic of patches and openings as recommended by the revised MSO recovery plan. Competition between trees for space, water, and sunlight would be greatly reduced, increasing individual tree health and growth. Small openings would be created across at least 10 percent of the area. The small openings would allow for early seral species such as aspen, pine, and oak to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. Any small openings created would also have the effect of increasing understory production and diversity.

Alternatives 2 and 3 are very similar; however because of the different harvesting methods, Alternative 2 would have slightly fewer large snags than Alternative 3 or 4. Alternative 2 has 360 acres of treatment that would be conducted utilizing cable yarding systems. Within those 360 acres, all snags would be felled and left in place due to operation safety requirements for cable yarding. Cable yarding also requires the construction of corridors for the cables to yard out the logs to be removed. These corridors would require approximately 10 percent of all tree species and sizes to be removed across the stand. This includes oak, maples, and trees over 18 inches dbh.

Table 85 below details the number of trees over 18 inches dbh that would be removed within MSO PACs. Also proposed in Alternative 2 is to treat 15 acres by cutting all the trees and leaving them in piles within the stand. The reason for this proposal is due to the high cost of building a temp road to access this area and the undesired resource impact the construction of the temp road would cause.

In Alternative 3 those 134 acres would be harvested using specialized steep slope harvesting machines which do not require the cutting of snags, oaks, or trees over 18 inches dbh. While the steep slope harvesting machines are similar to ground based equipment they are not as maneuverable on steep slopes as they are on flatter ground. The limited maneuverability may require the removal of snags, oaks, or trees over 18 inches dbh only when necessary for the machine to operate safely. However the removal of these forest components is anticipated to be negligible and would not impact the ability of those areas to meet desired conditions. Also in Alternative 3, 267 acres would be treated by helicopter logging. Within those 267 acres, all snags would be felled and left in place due to operation safety requirements for helicopter logging.

After 20 years BA, and canopy cover would be about the same, and % max SDI and large trees over 18 inches dbh would have increased slightly, while trees per acre will have decreased to 267. Then after 40 years, BA, canopy cover, and percent max SDI would have increased to 102 ft² of BA, 62 percent canopy cover, and 26 percent max SDI, all of which would still be significantly lower than the No Action Alternative. There would also be an average of 20 TPA over 18 inches dbh which is a key threshold for meeting the old growth criteria for the Forest Plan. The benefits of the thinning and burning treatments would last longer than 40 years.

Table 85: The number and percent of trees per acre over 18 inches dbh cut within MSO PACs of the DLH.

	Acres of Cable	TPA > 18” dbh cut	Total TPA >18” dbh	% of >18” trees cut
Mixed Conifer	314	1.6	15.0	10.6
Ponderosa Pine	44	3.8	37.3	10.2
Average		1.9	17.7	10.5

There would be two different treatments in the DLH’s nest cores. One nest core would receive a hand thinning treatment up to 5 inches dbh, with approximately 20 percent of that nest being deferred from thinning to retain vertical canopy diversity. The other two PAC nest cores would be treated with a prescribed burn only. After treatment, the average nest core conditions would be reduced from 112 to 92 ft² of BA; 63 percent to 58 percent canopy cover; 845 to 256 TPA; 52 percent to 41 percent max SDI; and 16 to 15 TPA greater than 18 inches dbh. Competition between trees for space, water, and sunlight would be reduced, increasing individual tree health and growth. Small opening may be created where the prescribed burn created pockets of mortality. The small openings would allow for early seral species such as aspen, pine, and oak to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics.

Any small openings created would also have the effect of increasing understory production and diversity. In the Schultz nest core that would be hand thinned, the open stand conditions would allow for prescribed fire to be reintroduced in a safe and controlled manner. Selective cutting of trees infected with dwarf mistletoe would help to reduce overall infection levels in the stand and improve overall stand health.

After 20 years BA would be 97 ft² and canopy cover 59 percent which would still be below current conditions. The percent max SDI would be 27 percent compared to the 46 percent current condition. Then after 40 years, the BA and Canopy Cover would be similar to current conditions, but TPA would be much lower at 126, and % max SDI would also be significantly lower at 29 percent. The benefits of the treatments would last at least 40 years related to relative density and improving individual tree growth and resiliency to fire, insects and disease.

The recovery habitat treatment include treatments for mixed conifer and ponderosa pine and treatment methods include ground based logging, cable yarding, helicopter, steep slope harvester, and hand thinning. The treatments would be designed to create a mosaic of patches and openings as recommended by the revised MSO recovery plan. Competition between trees for space, water, and sunlight would be greatly reduced, increasing individual tree health and growth. Small openings would be created across at least 10 percent of the area, with the exception of 20 percent openings in 181 acres of PFA treatment and 263 acres in the Pine-oak. The small openings would allow for early seral species such as aspen, pine, and oak to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. Any small openings created would also have the effect of increasing understory production and diversity. The open stand conditions would allow for prescribed fire to be reintroduced in a safe and controlled manner. Selective cutting of trees infected with dwarf mistletoe would help to reduce overall infection levels in the stand and improve overall stand health.

The effect of treatment in the recovery habitat areas reduces the BA from 140 to 65 ft² for Alternative 2, and 64 ft² of BA for Alternative 3, canopy cover is reduced from 71 to 50, and trees per acre are reduced from 1039 to 255 for Alternative 2 and 244 for Alternative 3, and percent max SDI is reduced from 54 percent (high density) to 22 percent (low density).

One of the differences between Alternatives 2 and 3 is harvest methods. In Alternative 2 there would be 514 acres (out of 1754) treated by cable yarding which would require the cutting of all snags and removal of trees over 24 inches dbh within the cable corridors. Table 86 summarizes the estimated number of trees over 24 inches dbh that would be removed, and Table 87 below details the number of trees over 18 inches dbh that would be removed. In Alternative 3 there would be 425 acres of helicopter logging, which would require the removal of all snags for operational safety. Also in Alternative 3 there would be 107 acres of steep slope harvesting. While the steep slope harvesting machines are similar to ground based equipment, they are not as maneuverable on steep slopes as they are on flatter ground. The limited maneuverability may require the removal of snags, oaks, or trees over 24 inches dbh only when necessary for the machine to operate safely. However the removal of these forest components is anticipated to be negligible and would not impact the ability of those areas to meet desired conditions. After treatment there would be 2 large snags per acre compared to 3 snags per acre in the No Action Alternative. The open stand conditions would allow for prescribed fire to be reintroduced in a safe and controlled manner. Selective cutting of trees infected with dwarf mistletoe would help to reduce overall infection levels in the stand and improve overall stand health by increasing the resiliency and resistance of trees to fire, insects and disease.

In 20 years, BA and canopy cover would all still be about the same. Trees per acres and percent max SDI would be increased slightly, also the number of trees over 18 inches dbh would have increased from 12 to 14. The number of trees would have increased due to regeneration in the openings. The number of large snags is about the same and is only slightly less than the no action The number of trees greater than 18 inches dbh would have gone up slightly but would still be less than the No Action Alternative.

In 40 years, BA, Canopy Cover, and SDI are all still significantly lower than the No Action Alternative. The number of snags and large trees are about the same compared to the No Action Alternative. Trees over 18 inches dbh would be less than the No Action Alternative: 17 TPA compared to 26 TPA. Overall stand density is still greatly lower than current conditions showing that thinning and burning treatments would have the positive effect of lower stand density for at least 40 years.

The effects of the Nest Roost Recovery Habitat treatment are the same as described for MSO Nest Roost Recovery Hand Thin.

Table 86: The number and percent of trees per acre over 24 inches dbh cut within MSO Recovery Habitat in the Dry Lake Hills

Recovery Habitat		TPA > 24" dbh cut	Total TPA >24" dbh	% of >24" trees cut
MC	514	0.4	4.3	9.3

Mexican Spotted Owl Habitat– Mormon Mountain

This section includes an analysis of the entire MSO habitat in the MM area, including ponderosa pine as well as dry and wet mixed conifer. All of the different treatments that occur within the four different MSO habitat stratas (MSO PACs, nest cores, recovery habitat, and nest roost recovery habitat) were combined to show the overall effects the treatments would have to MSO habitat.

Table 73 through Table 75 displays the value of the stands within the MSO PACS and recovery habitat, along with post-treatment data and stand conditions for all alternatives projected out 20 and 40 years.

Table 73 shows the stand attributes of all the combined treatments in all of the MSO PACs for MM. The average current condition has a BA of 158 ft², canopy cover of 74 percent, 1113 TPA, and percent max SDI is 65 percent. After treatment, those numbers would be reduced to: 76 ft² of BA, 54 percent canopy cover, 465 TPA, and 29 percent max SDI. The treatments would be designed to create a mosaic of patches and openings as recommended by the revised MSO Recovery Plan. Competition between trees for space, water, and sunlight would be greatly reduced, increasing individual tree health and growth. Small openings would be created across up to 10 percent of the area. The small openings would allow for early seral species such as aspen, pine, and oak to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. Any small openings created would also have the effect of increasing understory production and diversity.

Alternatives 2 and 3 are very similar; however Alternative 2 would include 74 acres of treatment that would be conducted through cable yarding systems. Within those 74 acres, all snags would be felled and left in place due to operation safety requirements for cable yarding. Cable yarding also requires the construction of corridors for the cables to yard out the logs to be removed. An additional 33 acres of wet mixed conifer stands would have cable corridors constructed through them to reach treatment areas below. These corridors would require approximately 10 percent of all tree species and sizes to be removed across the stand. This includes oak, maples, and trees over 18 inches dbh. Table 87 below details the number of trees over 18 inches dbh that would be removed. Even though the cable corridors have the effect of cutting 10 percent of all the trees it does not have the effect of creating 10 percent regeneration openings. Cable corridors are approximately 12 ft. in width and occur approximately every 100 feet. The length of the corridors depends on the length of the steep slope or the limitation of the equipment. A long linear cable corridor does not constitute an opening. Where the cable corridor runs through an area identified as an opening, that area of the corridor would be counted as part of the opening. Where the corridor runs through the middle of a group, it would not be considered an opening. It is common to have spacing greater than 12 feet in-between trees within a group. The residual basal area, canopy cover, and density would still be approximately the same compared to treatments not using cable harvesting methods.

In Alternative 3 those 72 acres would be harvested using specialized steep slope harvesting machines which do not require the cutting of snags, oaks, or trees over 18 inches dbh. While the steep slope harvesting machines are similar to ground based equipment, they are not as maneuverable on steep slopes as they are on flatter ground. The limited maneuverability may require the removal of snags, oaks, or trees over 18 inches dbh only when necessary for the machine to operate safely. However the removal of these forest components is anticipated to be negligible and would not impact the ability of those areas to meet desired conditions.

Because of the different harvesting methods, Alternative 2 would have slightly fewer large snags than Alternative 3: 3.9 versus 4.2. After 20 years BA, canopy cover, and percent max SDI would increase slightly, while trees per acre would decrease to 244. Then after 40 years, BA, canopy cover, and percent max SDI would increase to 102 ft², 62 percent canopy cover, and 34 percent max SDI, all of which would still be lower than under the No Action Alternative. There would also be an average of 20 TPA over 18 inches dbh, which is a key threshold for meeting the old growth criteria for the Forest Plan. The benefits of the thinning and burning treatments would last beyond 40 years.

Table 87: The number and percent of trees per acre over 18 inches dbh cut within MSO PACs on MM

	Acres of Cable	TPA > 18” dbh cut	Total TPA >18” dbh	% of >18” trees cut
Mixed Conifer	52	1.7	15.7	10.8
Wet Mixed Conifer	33	2	13.3	15
Ponderosa Pine	22	.3	7.4	4.1
Average		1.5	13.3	11.3

The only treatment that would occur in the MSO nest cores on Mormon Mountain would be a prescribed burn. After treatment, stand conditions would be reduced from 142 to 118 ft² of BA, from 71 to 66 percent for canopy cover, from 858 to 368 TPA, from 54 to 40 percent max SDI. TPA greater than 18 inches dbh would decrease slightly from 18 to 17. Competition between trees for space, water, and sunlight would be reduced, thus increasing individual tree health and growth. Small openings may be created where the prescribed burning creates pockets of mortality. The small openings would allow for early seral species such as aspen, pine, and oak to regenerate and would have the effect of helping to maintaining uneven-age stand characteristics. Any small openings created would also have the effect of increasing understory production and diversity.

After 20 years BA would be 140 ft^2 and canopy cover would be 70 percent, which is similar to current conditions. The percent max SDI would be 45 percent compared to the 54 percent in the current condition.

After 40 years, the overall density would be quite high, but still lower that the No Action Alternative after 40 years. The BA and canopy cover would be higher than current conditions whereas the TPA and percent max SDI would be lower. There would still be some benefits to the treatment after 40 years related to relative density and improving individual tree growth; however overall stand density and fire hazard would be greater than current conditions.

The effects of Recovery Habitat and Nest Roost Recovery Habitat treatments are the same as described for Ponderosa Pine Fuels Reduction.

Grasslands

Common to All Action Alternatives

The action alternatives would reduce the number of trees within areas that were historically grassland vegetation types. Under each alternative, mountain grasslands would be restored to presettlement densities. Removal of the forest trees would stop or reduce encroachment upon the grasslands. Broadcast burning would release nutrients bound up by dead fuel and help with the grassland recovery process (Grady and Hart 2006). Removal of pine encroachment would increase sunlight to meadow floor and increase forb and grass production and understory diversity (Grady and Hart 2006). Indirect effects of reduced densities in these areas include restoration of their functionality in terms of wildlife habitat, watershed production, fire hazard, and scenic values. Presettlement densities are an important reference condition for restoration because they are the densities that evolved in these areas over centuries with fire, drought, frost, wildlife, insects, and disease.

Aspen

Common to All Action Alternatives

The treatment would have the effect of removing all post-settlement conifer species from within 22 acres of the aspen stand in DLH under Alternatives 2 and 3, and 2 acres of the aspen stand in Alternative 4. The MM portion of the project does not contain any pure aspen stands. The treatment and effects to aspen within mixed conifer stands are addressed in the mixed conifer effects analysis portions of this document. Immediately after treatment, total TPA would also decrease; however the number of aspen per acre would remain the same (see Table 88). This represents the removal of conifer encroachment from aspen clones. Compared to the No Action Alternative, when treated there would be the same basal area after 20 and 40 years; however the number of TPA would be significantly less and would be comprised solely of aspens.

Aspen clones would experience increased health, growth, and vigor due to the removal of conifer encroachment. With increased health and vigor, aspen would be more resilient and less susceptible to disease, with increased longevity. Alternatives 2, 3 and 4 (to a more limited extent) would result in increased biodiversity and improved wildlife habitat across the landscape. The aspen clone may continue to expand over time but this expansion may be limited due to browse pressure from deer; elk browsing in this area is apparently limited by slope.

Table 88: Basal area and trees per acre for the Aspen Treatment areas under Alternatives 2, 3 and 4. These numbers do not include anticipated aspen regeneration (DLH)

TIME FRAME	BASAL AREA ALL SPECIES	BASAL AREA ASPEN	TREES PER ACRE ALL SPECIES	TREES PER ACRE ASPEN
EXISTING CONDITIONS	51	50	1687	739
POST-TREATMENT	50	50	738	739
No Action +20 YEARS	107	98	1493	652
Post Treatment +20 YEARS	106	106	712	712
No Action +40 YEARS	170	145	1190	519
Post Treatment +40 YEARS	170	170	626	626

Old Growth

Common to All Action Alternatives

These alternatives would designate 2,366 acres to be managed toward old growth conditions in the DLH and 2,196 acres in MM. See Table 89 for a breakdown of existing and designated acres by cover type. All of the acres in both project areas of existing or designated old growth would receive treatments under Alternatives 2 and 3. In Alternative 4, approximately 1,367 acres in DLH would be treated and 1,565 acres in MM would be treated. Treatments for each alternative would be designed to retain old trees and promote the growth of existing trees to become large old trees. The northern goshawk and revised MSO recovery plan both have guidelines to manage for uneven-age stand conditions. Most goshawk and MSO treatments across the project would retain groups of old trees even in stands not designated to be managed for old growth. As these stands continue to be managed for uneven-age conditions into the future, groups of old growth trees would be created across most stands and would be able to persist in a sustainable manner.

For stands that currently meet existing old growth requirements, treatments would be designed to retain all old growth characteristics, improve the health of old trees, and reduce the fire hazard for those stands. No yellow pines of any size would be cut under the action alternatives except for as needed for the creation of cable corridors for cable yarding operations in Alternative 2, and for extenuating circumstances as outlined in the design features. Treatments would decrease the mortality rate of existing yellow pines and old mixed conifer trees in treated areas. After thinning, old ponderosa pines experience increased diameter growth, water uptake and resistance to bark beetles. Thinning in and around old ponderosa pines also reduces the likely hood of mortality following prescribed burning or a wildfire (Kolb 2007).

Table 89: Acres and percent of currently allocated acres being managed for old growth by cover type and site potential, and the proposed acres for future old growth management located within FWPP.

Project Area	Cover Type	Acres of Cover Type	Acres of Currently Allocated	Proposed Acres for Old Growth Management	Total % of Existing and Designated
Dry Lake Hills	Interior Ponderosa Pine – High	4336	1183	972	22%
	Mixed Species Group – High (Mixed Conifer)	3118	1450	1372	44%
	Aspen	22	0	22	100%
Mormon Mountain	Interior Ponderosa Pine – High	1924	53	1157	60%
	Mixed Species Group – High (Mixed Conifer)	1051	561	1039	99%

Figure 57: Existing old growth and designated developing old growth located within the Dry Lake Hills area

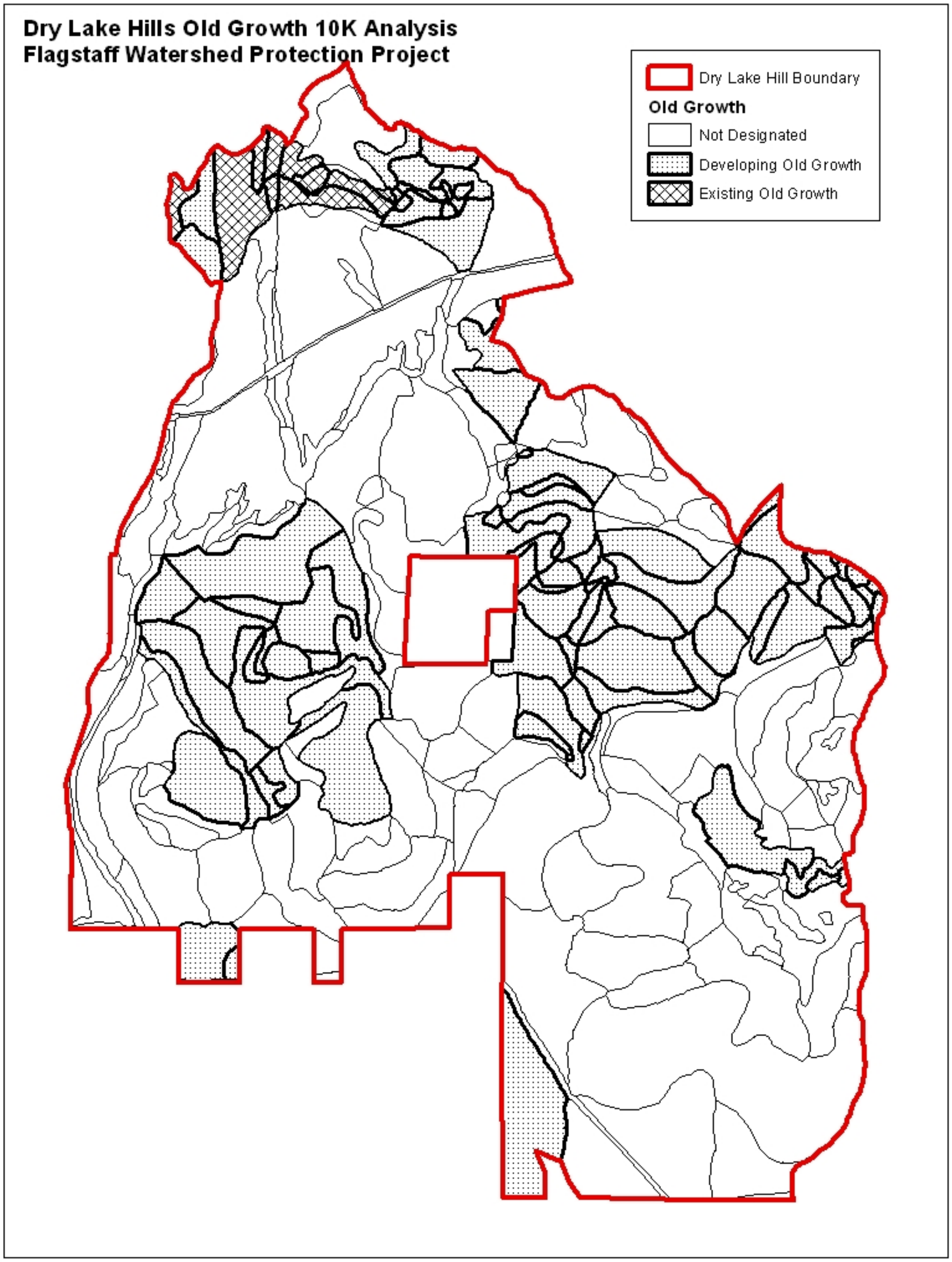
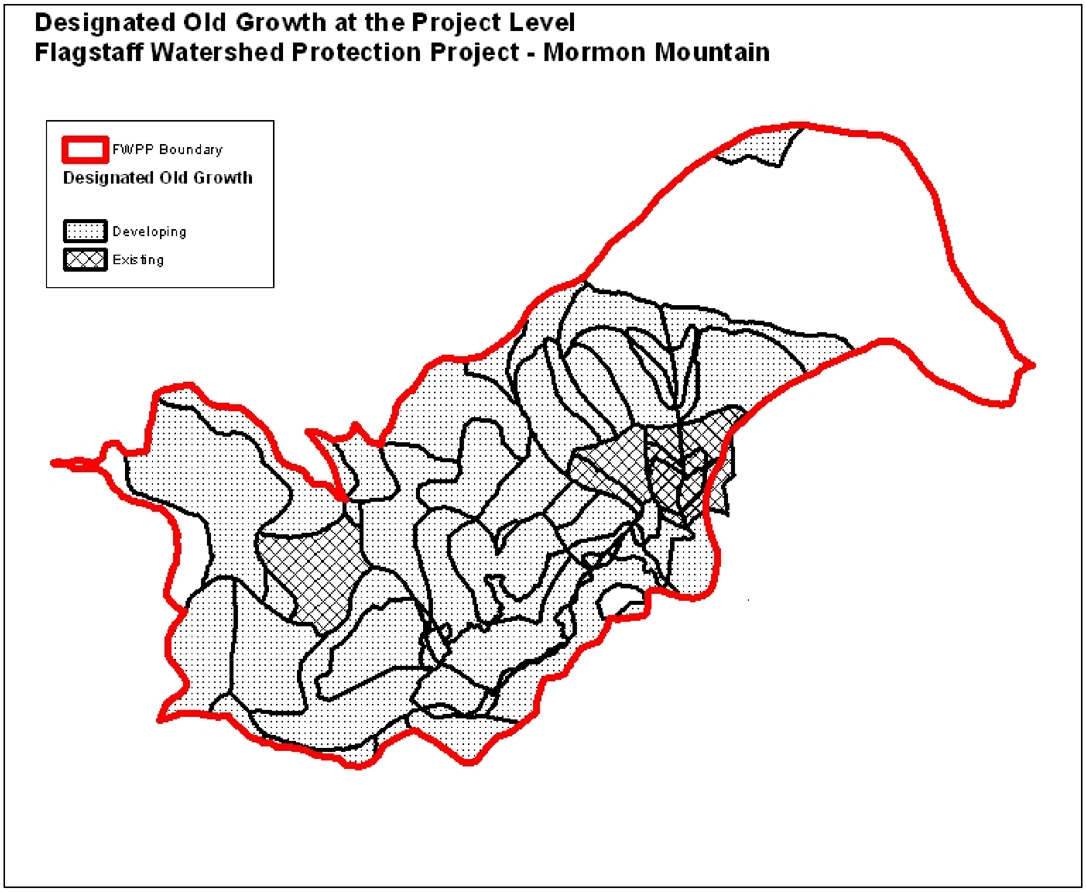


Figure 58: Existing old growth and designated developing old growth located within the Mormon Mountain area



Forest Health

Common to all Action Alternatives

Dwarf mistletoe is recognized as an endemic species and plays a natural role is the ecology of the forest. The following management recommendations set forth in the publication Dwarf Mistletoes and their Management in the Southwest (Conklin 2010) would be followed when treating stands infected with dwarf mistletoe. In lightly infected stands, where less than 25 percent of the area is infected, mistletoe would generally not be taken into consideration. Those lightly infected stands would be thinned similar to uninfected stands. In moderate to severe infected stands or groups careful consideration would be made on how to treat stands and would follow the recommendations of the afore mentioned publication. It is expected that dwarf mistletoe infection levels would be reduced slightly from current infection levels and would be relatively stable after thinning and burning treatments are completed.

The table below (Table 90) displays the current and post-treatment dwarf mistletoe infection levels for stands that have stand exams. The general trend shows that infections levels drop after vegetation treatments and then gradually start going back up again overtime. For the most part, the infection levels are similar or slightly increased 40 years after treatment. This analysis is based on summing up the percentage of stands with stand exam data across the entire cover type. The numbers below represent percentage of stands, not percentage of area. It would appear that in the DLH, 29 percent of the ponderosa pine is severely infected; however a disproportionate number of stands with high levels of mistletoe infection were inventoried for stand exams while some stands that have very little to no mistletoe were not inventoried. The actual number of acres in pine with severe infection is much less. The point of the table below is to show how the proposed management affects infection levels over time.

The data generally shows that treatment in most areas of the project would result in a decrease in infection levels, sometimes for several decades. The greatest effect of the treatments, however, would be to allow for low and moderate intensity fire to occur in the project area. Studies have shownt hat prescribed burning can be a viable tool to manage mistletoe effectively (Conklin and Geils 2008). The models below all factor in prescribed burning in 2015.

Table 90: Current conditions and post treatment Dwarf Mistletoe Infection Level of ponderosa pine and mixed conifer as a percentage of stands with stand exams within FWPP

		Current Conditions		2013		2033		2053	
Cover Type	Infection Level	DLH	MM	DLH	MM	DLH	MM	DLH	MM
Pine	None/Low	37	69	57	88	27	63	21	58
Pine	Moderate/ High	34	31	26	12	52	27	46	42
Pine	Severe	29	0	16	0	22	0	32	0
Mixed Conifer	None/Low	80	91	87	91	80	82	44	82
Mixed Conifer	Moderate/ High	20	9	14	0	19	18	51	9
Mixed Conifer	Severe	0	0	0	9	2	0	5	9

Current stand densities within the project area provide excellent habitat for increases in bark beetle and other insect populations. Insects are attracted to trees under stress from competition and a lack of resources, such as water, nutrients, and sunlight. The action alternatives would have an indirect effect on susceptibility to insect attack and mortality. Decreasing stand densities would reduce competition between trees, resulting in increased tree vigor and resilience. Individual trees would be better able to defend themselves against bark beetle attack (McMillin 2008, Negron 2009). After implementation of the treatments, the risk of insect attack and mortality for residual trees would be greatly reduced across the project area (Wallin et al. 2008).

Table 91 below shows the current and post treatment bark beetle hazard ratings for both DLH and MM. The treatments have a beneficial effect on the hazard ratings. Current conditions show the majority of stands have a high bark beetle hazard rating. After treatment, the majority of stands have a low hazard rating. Even after 40 years, bark beetle hazard ratings would remain significantly reduced.

Table 91: Current and Post Treatment Ponderosa Pine and Mixed Conifer Beetle Hazard Ratings (Percent of stands in each Project Area)

		2013 – Current Conditions		2013 - Post treatment		2033 – Post Treatment		2053 – Post Treatment	
Cover Type	**Hazard Rating**	**DLH**	**MM**	**DLH**	**MM**	**DLH**	**MM**	**DLH**	**MM**
Pine	Low	11%	3%	92%	13%	81%	75%	76%	41%
Pine	Moderate	13%	0%	5%	38%	14%	22%	22%	40%
Pine	High	76%	97%	3%	50%	5%	3%	3%	22%
Mixed Conifer	Low	0%	27%	69%	55%	51%	36%	32%	36%
Mixed Conifer	Moderate	5%	0%	17%	0%	32%	27%	41%	9%
Mixed Conifer	High	95%	73%	14%	45%	17%	36%	27%	55%

Cumulative Effects for Alternatives 2, 3 and 4

The spatial boundary for this cumulative effects analysis includes the surrounding watersheds and landscape in the Flagstaff Ranger District; the forest conditions in these areas affect the forest conditions in the project area and are considered in conjunction with the FWPP project area for Forest Plan guidelines related to goshawk and old growth. Reasonably foreseeable activities to occur in the next 10 years are considered for cumulative effects in this analysis even though direct and indirect effects are modeled out to 40 years as after 10 years, the cumulative actions and their effects are too speculative to accurately analyze.

Table 92 and Table 93 list the various vegetation management, fuels treatments and other activities that have recently occurred, ongoing, or are likely to happen soon. The DLH area lies in between and overlaps two other fuels reduction projects the Eastside fuels reduction project to the south, and the Jack Smith / Schultz fuels reduction project to the north. The Fort Valley Fuels Reduction project lies to the west. The DLH area is largest area adjacent to the community of Flagstaff that has not received fuels reduction treatment. This proposed action would complete a wide swath of fuels reduction treatment that was started around Flagstaff approximately 20 years ago.

The MM treatment area lies on the north slopes of Mormon Mountain and drains into Lake Mary. While there are no on-going projects immediately adjacent to the project boundary, there are two nearby active projects. The Mormon Lake basin project to the south is a fuels reduction and forest health project to help protect Mormon Lake Village. To the north is the Elk Park Fuels Reduction and Forest Restoration project which is also located in the Lake Mary watershed. The 4FRI analysis area includes lands adjacent to the MM area, and is included in the table below.

Table 92: FWPP Cumulative Effects Project List of past, present, and reasonably foreseeable actions in the Dry Lake Hills project area and surrounding areas

	PAST	**PRESENT (ONGOING)**	**REASONABLY-FORESEEABLE**
Forest Thinning & Burning Projects	Fort Valley Experimental Forest (thinning & burning)		
		Wing Mountain Fuels Reduction and Forest Health Restoration Project. 4FRI task orders will be issued to treat the Wing Mountain Project beginning in 2015.	
	Eastside Fuels Reduction Project: approx. 16 acres of thinning around Elden communication towers done around 2008; 85 acres hand thinning along Elden Lookout Rd (past and ongoing); part of the Weatherford task order outside FWPP project area (along with Jack Smith Schultz). Hand thinning occurring within the FWPP project boundary currently and on-going.		
	Jack Smith Schultz Fuels Reduction Project (and ongoing) Orion task order (867 acres)for 4FRI to be issued in 2014. Weatherford 4FRI task order (1017 acres) issued in 2013 Hand thinning occurring within the FWPP project boundary currently and on-going.		
	Elden Small Project (thinning and burning on 200 acres) 2002		
			4FRI – Would treat areas in the Fort Valley area and adjacent urban interface areas. The preferred alternative includes a total of 434,001 acres of mechanical thinning and 593,211 acres of prescribed burning to be implemented over the next 20 years.
			Treatments on the Navajo Nation parcel (approx. 140 acres) as well as adjacent State and private land
Wildfires	Schultz Fire (2010) 15,075 acres. BAER work included mulching, seeding and salvage, and hazard tree mitigation.		
	Radio Fire (1977)		

	PAST	PRESENT (ONGOING)	REASONABLY-FORESEEABLE
	4,594 acres		
Restoration Work			4FRI Spring Enhancements
	Reforestation of 1000 acres of the Schultz fire. Includes planting and jackstrawing.	Reforestation of severely burned areas.	
	Schultz Sediment Reduction – channel restoration work performed between FR 420 and the forest boundary on the National Forest by Coconino County to reduce erosion into the neighborhoods.		
Recreation	Arizona Trail construction		
		Special Use Events	
		Fort Valley Motorized Trails	
		Multi-use throughout DLH (hiking, mountain biking, camping) and trail maintenance	
			Expanded Mt. Elden and Dry Lake Hills Trail System
		Hunter Access to Aspen Depredation	
Grazing	Peaks Allotment (pastures not grazed in over 10 years; deferred from grazing now)		
Lands Projects			Elden/Devils Head comm sites – potential tower additions
	Travel Management Rule		

Table 93: FWPP Cumulative Effects Project List for past, present, and reasonably foreseeable actions in the Mormon Mountain project area and surrounding area

	PAST	PRESENT (ONGOING)	REASONABLY-FORESEEABLE
Forest Thinning & Burning Projects	Mormon Lake Basin Fuels Reduction Project. MLB #1 Stewardship Contract (1597 acres)Completed in	MLB #2 Stewardship Contract thinning in progress (568 acres).	

	PAST	PRESENT (ONGOING)	REASONABLY-FORESEEABLE
	2013		
			4FRI – Would treat much of the area around Mormon Mountain and the Lake Mary Watershed with mechanical vegetation treatment and prescribed burning.
		Elk Park Project: Elk Park and Clark 4FRI task orders issued in 2013 will treat approximately 4,600 acres in the Lake Mary Watershed	
	Thinning around communication towers (11 acres) 2007-2008		
Wildfires	Small, low acreage (see Existing Conditions – Fire/Fuels)		
Restoration Work			4FRI Spring Enhancements
Recreation		Dispersed recreation	
		Hunting	
		Fuelwood gathering	
Grazing	Tinny Springs Allotment: Five hundred cow/calf pairs are permitted to graze on the Tinny Springs allotment from June 1 through October 31 using a deferred rotation grazing system.		
	Pickett Lake/Padre Canyon Allotment: Nine hundred 13 adult cattle are permitted to graze on the allotment from June 1 through September 30 using a deferred, rest rotation grazing system.		
Lands Projects	Mormon Mt APS Line – final rehab needed but mostly complete		
			APS Youngs to Mormon Lake new 69kv line
	Mormon Mt Comm Site		
		FH3 Tree Clearing	
	Travel Management Rule		

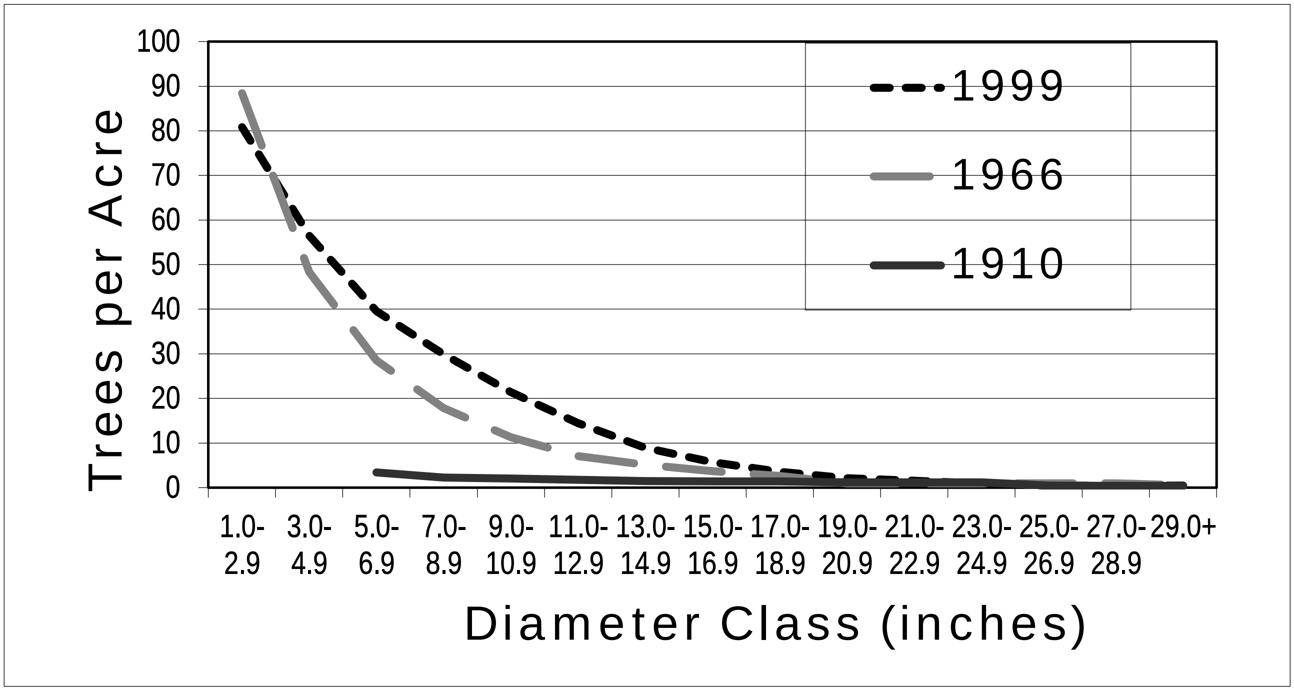
Cumulative Effects – Past Actions

Over the past century, several events, including fire exclusion, livestock grazing, and high-grade timber harvesting, occurred in ponderosa pine over the majority of the project area and in adjacent stands. These events resulted in disruption of the historic fire regime that consisted of frequent, low-intensity surface fires. In 1919, climatic events favored dense ponderosa pine regeneration. At this time, understory production was greatly decreased by grazing and offered little competition with pine regeneration. As fire suppression and sawlog harvesting continued through the 20th century, regeneration from 1919 continued to grow in density. In the mid- to late 1900s, treatments in and adjacent to the project area removed a large proportion of the mature and old trees, contributing to a more even-aged forest structure. At the same time pre-commercial thinning treatments occurred that reduced the density of younger forest, mainly through even spacing of residual trees.

Although these treatments did provide some short-term improvement to forest health, vigor, and growth by reducing stand densities and increasing the growing space of individual trees, they also caused further departure from the variable, patchy tree distribution that typified the historic ponderosa pine forest structure. Blending treatments were used to produce a single age class deemed “more manageable” in terms of regulated timber harvesting. Past events have resulted in increased stand densities, decreased age and size class diversity, altered stand structure, changes in successional dynamics, altered insect and disease dynamics, decreased understory productivity and diversity, decreased tree vigor, increased fuel accumulation and continuity, increased crown fire potential, increased fire size and intensity, and a more even-aged forest structure (Long 2003).

Figure 59 depicts changes in trees per acre by size class on non-reserved forest lands in New Mexico and Arizona. The graph below (Figure 59) depicts changes that are typical of southwest ponderosa pine. The density of trees has increased significantly over time, especially in diameter classes less than 13 inches. With this tremendous increase in smaller size classes, size class diversity has decreased, resulting in a more even-aged forest structure.

Figure 59: Changes in stand density in southwestern ponderosa pine, non-reserved forest lands, NM and AZ (USDA Forest Service 2004).



Cumulative Effects – Alternatives 2, 3, and 4

Alternative 2 would contribute an additional 8,937 acres toward improving forest health or fuels reduction and vegetation diversity/composition, sustaining old forest structure over time, and moving forest structure toward the desired conditions.

Alternative 3 would contribute an additional 8,937 acres toward improving forest health or fuels reduction and vegetation diversity/composition, sustaining old forest structure over time, and moving forest structure toward the desired conditions.

Alternative 4 would contribute an additional 5,802 acres toward improving forest health or fuels reduction and vegetation diversity/composition, sustaining old forest structure over time, and moving forest structure toward the desired conditions.

The recently-signed decision on the Coconino Travel Management Rule (September 2011) designated a road system of reduced mileage across the forest, which included closing a number of roads within the project area to the public. This reduced road system available to the public would have a cumulative effect with road decommissioning from this project to reduce the amount of snags and down woody removed for fuelwood harvest (Wisdom 2008) away from designated roads. This cumulative impact would partially counteract the effects of the proposed action that include a reduction in downed woody material over the next decade as the thinning and prescribed fire treatments would be implemented.

With the advent of global climate change, more frequent and higher intensity wildfires are expected (Marlon et al. 2009). Future droughts and temperature increase would also likely result in greater tree mortality from more frequent and higher intensity outbreaks of bark beetles (Van

Mantgem et al. 2009, Williams et al. 2010). This project would make the forest more resilient and thus counteract the effects of climate change.

The proposed treatments in this EIS, in combination with ongoing projects adjacent to the project area, would result in a landscape which is more open, variable, and groupy for a minimum of 20 years into the future. The creation of openings and a more open canopy would result in increased natural regeneration across the landscape and a more uneven-aged forest structure, which would move conditions toward the desired condition of a well distributed age class with large, resilient trees in an uneven-aged structure across the landscape. A mosaic of varying forest structures, patterns, densities, and size classes results in increased horizontal and vertical heterogeneity, increased biological diversity, improved forest health, and a more sustainable forest structure at the landscape-level. A more sustainable forest structure is more resilient and capable of maintaining its health in the face of climate change and other disturbances such as insects, disease, and severe wildfires, which are expected to intensify under projected changes to the climate. The proposed alternatives and ongoing treatments would result in a decreased risk of insect attack and mortality at both the project and landscape levels.

Slash created from thinning activities would have the potential to increase brood habitat for *Ips* beetles and the potential for higher intensity ground fires from slash burning. The result of slash would be short-tern, until the site is treated with prescribed fire. Increased regeneration of ponderosa pine is expected to occur, but dog-hair thickets may be controlled through the planned maintenance burning (every 5 to 7 years in ponderosa pine).

These treatments would also result in faster development of a landscape-level VSS distribution recommended for the northern goshawk by retaining large trees, creating openings for regeneration, and increasing tree growth and vigor. Thus the cumulative effects of similar treatments within the landscape would be to move toward desired vegetation structure and age class diversity at the landscape scale over the next several decades. The treatments within the MSO PACs from projects such as Wing Mountain Fuels Reduction and Forest Health Restoration Project, 4FRI, Eastside Fuels Reduction Project and others would increase the resiliency of those stands to withstand wildfires and insect and disease attacks, which would support these areas in meeting desired conditions in the coming decades. The creation of small regeneration openings and restoration of historic grasslands and aspen stands across the landscape would also result in increased understory abundance, increased diversity at the landscape scale, and increases in insects, such as butterflies, that serve as prey bases for a suite of wildlife species. Increased grass and forb production would help spread and carry natural periodic surface fires. Lastly, by focusing on the removal of smaller diameter trees, this and other projects would retain and produce larger diameter trees for both ecological and social/aesthetic values.

Alternative 4: Minimal Treatment

Where applicable, effects from Alternative 4 were included in the above discussion for Alternatives 2 and 3 (under each section titled “Effects Common to all Action Alternatives”). In general, only those differences between Alternative 4 and the other action alternatives are included here.

Direct & Indirect Effects

Ponderosa Pine – Dry Lake Hills (Northern Goshawk)

Under Alternative 4, fewer acres would be treated in the Ponderosa Pine Fuels Reduction and Goshawk PFA Fuels Reduction. There would be no treatment on steep slopes which would require cable yarding, helicopter, or specialized steep slope equipment. The treatment intensity in treated areas would remain the same as the other alternatives. The current conditions and post-treatment conditions are mostly similar in the LOPFA and PFA treatments between Alternative 4 and Alternatives 2 and 3. Alternative 4 post-treatment BA in LOPFA would be slightly lower and have higher number of TPA than Alternatives 2 and 3. Alternative 4 would only have 10 percent in VSS 6 compared to 27 percent for Alternative 2 and 3. This is because many of the areas that would become VSS 6 in Alternatives 2 and 3 would not be treated under Alternative 4. Many of the areas that would be treated under Alternative 4 do not have the large tree component necessary to create VSS 6. In the PFA, Alternative 4 would have a higher number of residual snags and large trees immediately post-treatment compared to Alternatives 2 and 3 due to the subset of acres currently contain a higher average number of snags and large trees. The PFAs would have no VSS 4, and a greater amount of VSS 5 and 6 compared to Alternatives 2 and 3. Goshawk nest treatments are the same in all the action alternatives.

Ponderosa Pine – Dry Lake Hills (MSO)

The 230 acres treated in this alternative is a smaller sub-set of the 379 acres in Alternatives 2 and 3. This alternative does not utilize any steep slope harvesting methods. The post-treatment BA and canopy cover on these acres would be lower to Alternatives 2 and 3 and this subset would also have a higher number of TPA and fewer large trees and snags. The post-treatment numbers show these acres would have a lower BA, canopy cover, and percent max SDI than the No Action Alternative. In 20 years after treatment, the models still show these acres would have a lower BA, canopy cover, and percent of max SDI compared to Alternatives 2 and 3. However, 40 years after treatment BA, canopy cover, percent max SDI and number of large trees would be very similar to Alternatives 2 and 3. This is due to the more open conditions allowing for medium size trees to grow into larger trees at a faster rate than the denser Alternative 2 and 3 conditions; in other words, current stand conditions in Alternative 4 treatment areas have fewer large trees to begin with, thus less overall density. Also the areas that would be treated under this alternative would have a lower overall dwarf mistletoe infection level than current conditions.

Ponderosa Pine – Mormon Mountain

The effects of Alternative 4 on the area proposed for Ponderosa Pine Fuels Reduction treatment on Mormon Mountain would be similar as those discussed for Alternatives 2 and 3, as the proposed treatment for pure ponderosa pine stands is the same under all three action alternatives.

Mixed Conifer – Dry Lake Hills

The effects of the Mixed Conifer Fuels Reduction Treatment would be very similar to the effects described for Alternatives 2 and 3. As shown in Table 70, the two main differences would be that only 542 acres would be treated as opposed to 1140 acres or 1158 acres under Alternative 2 and 3, respectively, and there would be no steep slope harvesting methods used to treat stands in Alternative 4.

The 337 acres of MSO PAC Fuels Reduction treated in this alternative is a smaller sub-set of the 816 acres that would be treated in the other two action alternatives. This alternative does not utilize any steep slope harvesting methods. As shown in Table 70, the BA and canopy cover post-treatment on these acres would be similar to Alternatives 2 and 3, this subset would have a higher number of snags. In both 20 and 40 years, this subset would continue to have very similar conditions. The effects would be the same as described for Alternatives 2 and 3, but on fewer acres.

Mixed Conifer – Mormon Mountain

Effects from Alternative 4 on MSO nest cores and wet mixed conifer would be the same as those described for the No Action Alternative, as no treatment would occur within MSO nest cores on Mormon Mountain under Alternative 4.

Effects to MSO PACs would be the same as described for Alternatives 2 and 3 except to a lesser degree as fewer acres would be treated (448 acres).

Mexican Spotted Owl Habitat– Dry Lake Hills

The effects to MSO PACs in Alternative 4 would be very similar to the effects described in Alternatives 2 and 3. However Alternative 4 would focus on treating the Schultz and Elden PACs. No treatment would be done in the Orion or Weatherford PACs. Treatments would only be conducted with conventional ground based logging equipment or done with hand thinning. There would be no treatments on steeps slopes in this alternative. Table 94 shows some of the minor differences in stand attributes are that BA and canopy cover are a little lower after treatment, and the average number of large snags is higher compared to Alternatives 2 and 3. After 20 and 40 years the stand attributes are virtually identical, as are the overall treatment effects.

The effects to recovery habitat in Alternative 4 are very similar to the effects described in Alternatives 2 and 3. However the areas included in Alternative 4 would be treated with conventional ground based logging equipment. There would be no treatments on steeps slopes in this alternative. Some of the minor differences in stand attributes are that BA is a little lower after treatment, and the average number of large snags is higher compared to Alternatives 2 and 3. After 20 and 40 years the stand attributes are virtually identical, as are the overall treatment effects.

Table 94 through Table 96: Within the DLH portion of FWPP: Stand values for MSO PAC, recovery and nest roost recovery habitat. Values displayed are for current conditions, conditions after treatment, and stand values for treated and not treated areas projected out 20 years and 40 years.

Table 94: Dry Lake Hills - Current and Post Treatment Stand Values

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
Current Condition (No Action)								
MSO PAC	1275	133	69	824	52%	9	4	16
MSO PAC - Nest	382	112	63	845	43%	5	3	16
Nest Roost Recovery	72	148	72	2986	71%	16.23	2.4	7
Recovery	1754	140	71	1039	54	7.9	3.3	14
After treatment								

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
MSO PAC Alt 2	1275	89	59	213	20%	6	3	17
MSO PAC Alt 3	1303	90	59	184	21%	7	4	17
MSO PAC Alt 4	688	82	57	144	18%	6	3	14
MSO PAC - Nest Alts 2 & 3	382	92	58	256	28%	12	5	15
MSO PAC - Nest Alt 4	122	111	65	540	41%	6	4	13
Nest Roost Recovery – Alts 2 & 3	72	99	62	421	34%	15.4	2.3	7
Recovery – Alt 2	1754	65	51	255	22	4.9	2.1	12
Recovery – Alt 3	1741	64	50	244	22	5.3	2.2	12
Recovery – Alt 4	1040	63	50	279	24	6.2	2.6	12

Table 95: Dry Lake Hills - Projected 20 Years

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
Current Condition (No Action)								
MSO PAC	1275	150	72	735	44%	7	3	19
MSO PAC - Nest	382	142	69	673	46%	5	2	20
Nest Roost Recovery	72	173	76	2386	75%	5.6	1.5	8
Recovery	1754	167	75	939	61	4.7	2.0	22
After treatment								
MSO PAC Alt 2	1275	90	59	276	23%	5	3	19
MSO PAC Alt 3	1303	89	59	267	23%	6	3	18
MSO PAC Alt 4	688	85	58	224	20%	5	3	15
MSO PAC - Nest Alts 2 & 3	382	97	59	156	27%	8	3	17
MSO PAC - Nest Alt 4	122	111	65	199	35%	5	2	15
Nest Roost Recovery – Alts 2 & 3	72	78	56	172	23%	6	1.5	11
Recovery – Alt 2	1754	66	51	298	25	3.3	1.8	14
Recovery – Alt 3	1741	65	51	305	25	3.3	1.8	15
Recovery – Alt 4	1040	65	50	298	26	3.3	2.0	14

Table 96: Dry Lake Hills - Projected 40 Years

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
Current Condition (No Action)								
MSO PAC	1275	165	74	638	47	7	3	23
MSO PAC - Nest	382	163	72	479	49%	6	2	24

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”
Nest Roost Recovery	72	201	80	1904	79%	5.1	1.2	19
Recovery	1754	192	79	826	65	4.8	1.7	26
After treatment								
MSO PAC Alt 2	1275	102	62	256	26	4	3	20
MSO PAC Alt 3	1303	102	63	248	26	4	3	20
MSO PAC Alt 4	688	101	62	208	23	4	2	20
MSO PAC - Nest Alts 2 & 3	382	112	62	126	29%	5	3	21
MSO PAC - Nest Alt 4	122	142	71	183	41%	3	1	20
Nest Roost Recovery – Alts 2 & 3	72	93	60	165	26%	1.6	.8	17
Recovery – Alt 2	1754	82	57	282	27	2.1	1.4	17
Recovery – Alt 3	1741	81	56	288	28	2.0	1.4	17
Recovery – Alt 4	1040	83	57	282	30	2.1	1.5	16

Mexican Spotted Owl Habitat– Mormon Mountain

This alternative would treat a smaller subset of Alternatives 2 and 3, the main difference being that no treatments would be conducted on steep slopes. The average density, number of TPA, and snags per acre would be less in Alternative 4 as the areas that are not being treated are not averaged into the numbers; those untreated areas are of high density and contain high numbers of TPA and snags per acre. Also the ratio of pine to mixed conifer is higher in this alternative. Since pine would be treated at a higher intensity, the average numbers for this sub-set of acres are lower than the other alternatives. The effects on MSO recovery habitat and nest roost recovery habitat are the same as described for Alternative 2 and 3.

Table 97 through

Table 99 show stand values for MSO PAC, recovery and nest roost recovery habitat. Values displayed are for current conditions, conditions after treatment, and stand values for treated and not treated areas projected out 20 years and 40 years.

Table 97: Mormon Mountain - Current and Post Treatment within MSO Habitat

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18”	% BA 12-18”	% BA 18”+
Current Condition (No Action)										
PAC – Alt 1	1772	158	74	1113	65	12.2	4.4	15		
PAC Nest Burn Only Alts 1 & 4	402	142	71	858	54	22.0	8.5	18		
Recovery - Alt 1	776	161	74	730	74	4.3	.5	16		
Nest Roost	22	173	76	949	87	5	1.3	39	17%	61%

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18"	% BA 12-18"	% BA 18"+
Recovery										
After treatment										
PAC – Alt 2	1772	76	54	465	29	10.3	3.9	15		
PAC – Alt 3	1772	77	55	466	30	11.0	4.2	15		
PAC – Alt 4	1509	70	53	450	29	9.5	3.2	16		
PAC Nest Burn Only Alts 2 & 3*	402	118	66	368	40	20.8	7.6	17		
Recovery - Alts 2,3,4	776	60	49	534	31	4.1	.5	9		
Nest Roost Recovery Alts 2, 3, 4	22	120	67	906	64	4.8	1.3	19	19%	49%

Table 98: Mormon Mountain - Projected 20 Years within MSO Habitat

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18"	% BA 12-18"	% BA 18"+
Current Condition (No Action)										
PAC	1772	183	77	887	68	6.9	2.0	21		
PAC Nest Burn Only Alts 1 & 4	402	174	76	779	61	4.6	2.4	23		
Recovery - Alt 1	776	177	77	598	76	6.9	1.1	23		
Nest Roost Recovery	22	182	77	742	86	7.6	2.7	43	21%	68%
After treatment										
PAC – Alt 2	1772	82	57	244	29	2.2	2.1	17		
PAC – Alt 3	1772	82	57	243	29	2.3	2.2	17		
PAC – Alt 4	1509	76	55	227	28	2.0	1.9	17		
PAC Nest Burn Only Alts 2 & 3	402	140	70	352	45	4.9	2.6	21		
Recovery - Alts 2,3,4	776	65	51	222	28	2.1	.8	11		
Nest Roost Recovery Alts 2, 3, 4	22	131	69	448	60	3.8	1.2	22	30%	57%

Table 99: Projected 40 Years within MSO Habitat - MM

	Acres	BA (ft2)	CC (%)	TPA	% Max SDI	Snag 12+	Snag 18+	Trees >18"	% BA 12-18"	% BA 18"+
Current Condition (No Action)										
PAC – Alt 1	1772	205	80	729	70	8.0	2.2	27		
PAC Nest Burn Only Alts 1 & 4	402	204	80	678	63	4.7	2.0	27		
Recovery - Alt 1	776	184	78	506	75	9.8	2.1	30		
Nest Roost Recovery	22	190	78	608	86	7.5	3	40		
After treatment										
PAC – Alt 2	1772	101	62	230	33	2.4	1.8	20		
PAC – Alt 3	1772	102	62	229	34	2.5	1.9	20		
PAC – Alt 4	1509	94	60	213	32	2.3	1.7	20		
PAC Nest Burn Only Alts 2 & 3	402	165	75	324	49	4.4	2.0	27		
Recovery - Alts 2,3,4	776	85	58	208	34	2.3	1.1	14		
Nest Roost Recovery Alts 2, 3, 4	22	154	73	410	67	2.5	.7	24		

Grasslands, Aspen, Old Growth and Forest Health

The effects of Alternative 4 on grasslands, aspen, old growth and forest health are discussed in those respective sections of Alternative 2 and 3. However, since Alternative 4 would treat approximately 20 fewer acres of aspen stands, the analysis discussed under Alternatives 2 and 3 would only pertain to the two acres proposed for treatment under Alternative 4. The following is the analysis of the untreated acres of aspen stands.

Under the Alternative 4, forest conditions within the 20 acres of untreated aspen stands would remain much as they are now. Only two acres of treatment within the pure aspen stands is proposed under Alternative 4. Over 40 years (assuming no other dramatic aspen die-off occurs), basal areas of both aspen and conifer species would increase in the untreated acres, and TPA would decrease. The basal area increase of the conifer trees would be greater than aspen and would result in a greater rate of decline for aspen trees per acre. Increased canopies of conifer species would compete with and shade out the shade-intolerant aspen crowns. Closed crown canopies would result in decreased sunlight to the forest floor, decreased understory productivity and diversity, increased inter-tree competition, decreased tree health, growth and vigor, increased insect and disease-related mortality especially in older age classes, and decreased horizontal heterogeneity (Zegler et al. 2012, Calder et al. 2011).

Irreversible and Irretrievable Commitments of Resources

Each action alternative is designed to reduce the potential for high intensity wildfire and modify forest structure to perpetuate key forest elements such as large, old, trees and snags. Thus, there would be no irretrievable, irreversible effects to vegetation within the project area. The temporary loss of resources would only occur in places where roads would be constructed in forested areas to implement the proposed treatments. Production of timber would be temporarily lost within the road prism due to use of the road and the compaction that would occur. Temporary roads and log landings would be rehabilitated once treatments are complete. The loss of timber production would last during the time the temporary road are being used and for a few years after the road has been rehabilitated for the time that it takes for the compacted soil to naturally loosen up.

The effect of the temporary loss of timber productivity would have a minor impact in the short term and a minimal impact to the functionality of the forest over the long term. The impact is spread out over a large area and would not measurably decrease overall timber or understory production except for when the harvesting is occurring.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

The following is a description of how the forest plan amendments under this EIS would modify the forest plan standards and guidelines and what the effects to the vegetation resource would be if the amendment did not occur.

- **Amendment 1**
    - If the amendment did not occur: 1) Mechanical treatments would be limited to a maximum of 9” dbh in the PACs thereby restricting the treatment to an ineffective fuels reduction objective and reducing the ability to improve MSO habitat in terms of reducing overall stand densities to desired levels, creating groups, openings, increasing or maintaining age class and species diversity, and liberation of overtopped oak.; 2) Without the use of prescribed fire in MSO core areas, the opportunity to improve MSO habitat in terms of reducing litter/duff cover and stimulating regeneration and growth of native herbaceous vegetation would be eliminated; 3) Treatments within MSO habitat would continue to meet the intent of the 1995 MSO recovery plan 4) Mechanical treatments within the nest roost recovery habitat would follow the denser 150 ft^2 basal area guidance thereby reducing the ability to improve MSO nesting/roosting habitat in terms of sustainability, as indicated by high potential for density related mortality and high bark beetle hazard rating as well as reducing the ability to improve age class and species diversity and the liberation of overtopped oak; 5) Implementation of vegetation treatments within the PACs would take 2 to 3 additional years.; 6) Following existing Forest Plan language concerning MSO population and habitat monitoring or MSO habitat design would not have an effect on the treatments themselves or their outcomes.

      The result of the Forest Plan amendment is to facilitate mechanical thinning and prescribed fire in Mexican spotted owl habitat at a level necessary to meet the desired conditions and 2012 Mexican Spotted Owl Recovery Plan guidelines for forest structure and composition. This Forest Plan amendment will result in moving conditions toward a forest structure more in-line with the revised MSO recovery plan. The amendment would also have the effect of allowing thinning treatments which would enable managers to apply prescribed fire to the forest in a safe and effective manner. Furthermore the effect of this amendment would be to facilitate treatments to re-establish small openings that would result in greater understory biodiversity, improve the diversity of age classes, and reduced inter-tree competition and resilience to wildfire, drought, insects, and disease.

- **Amendment 2**
  - If the amendment did not occur: It would not be technically feasible to treat areas on steep slopes to meet the desired conditions; Manual treatment (hand thinning and piling) would only be able to treat trees up to 9" in diameter due to safety concerns; Not treating to the desired condition would not allow for the safe use of prescribed fire on steep slopes in many areas of the project; In areas where prescribed fire could be done in terms of firefighter safety, the fire would not have the desired effect, and would cause high levels of mortality across the burned areas which would not achieve the desired fuels reduction and post fire flooding reductions.

    The result of the forest plan amendment is to allow for use of specialized mechanical equipment to cut and remove trees on steep slopes to reduce the potential forf high-severity wildfire in this project area due to the preponderance of areas with greater than 40 percent slope in the project area. This amendment is needed. in order to be able to utilize such equipment to treat slopes above 40 percent in the project area in order to create the desired conditions and meet the purpose and need of this project.

Soil & Water Resources

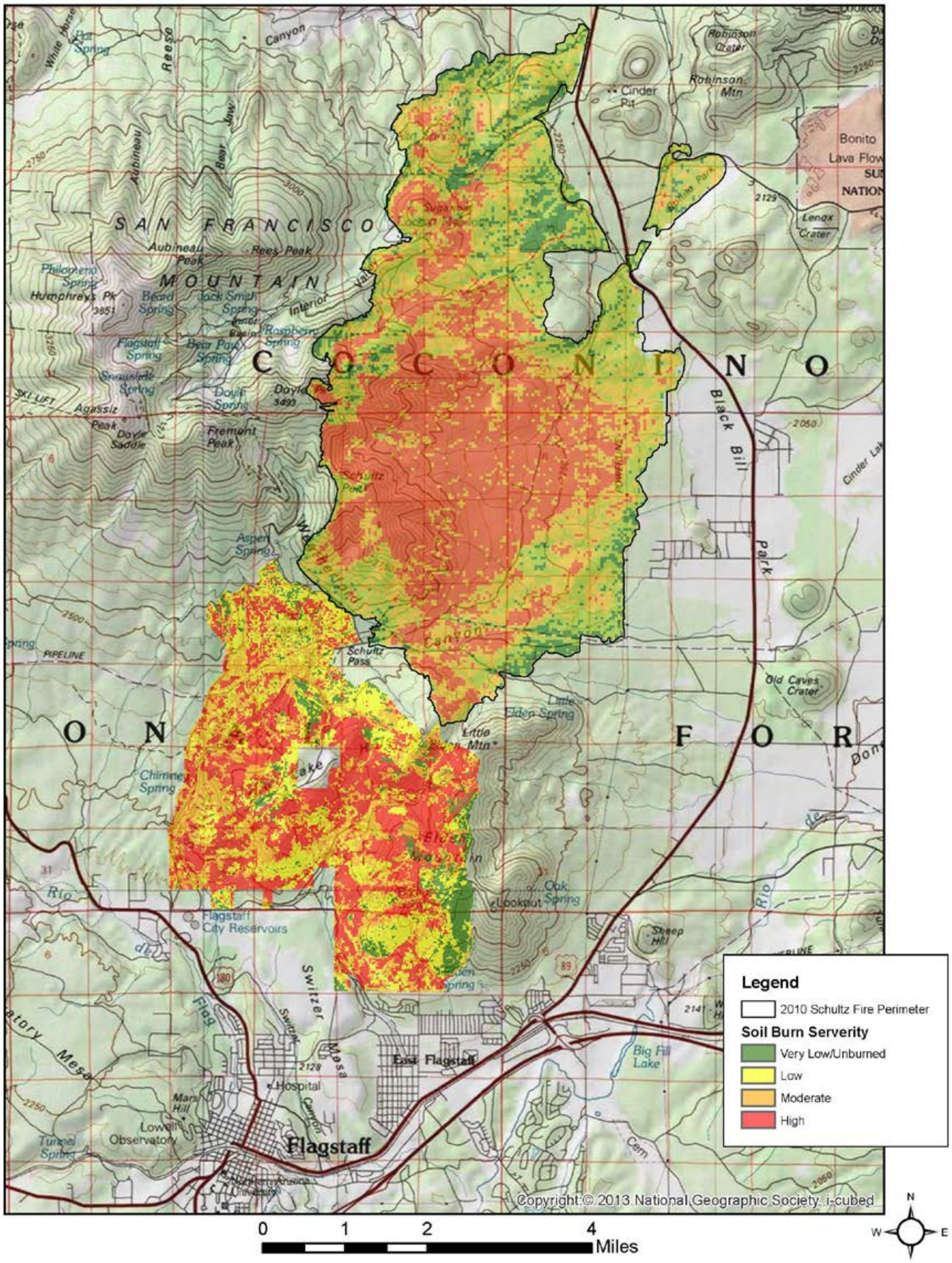
Methodology

Soil Burn Severity

Soil burn severity has been identified as a key indicator of the susceptibility of a burned area to accelerated erosion and flooding and, consequently, soil burn severity categories are used to determine appropriate soil and hydrologic parameters needed for post-fire runoff and erosion modeling. For this project, soil burn severity maps were generated for the No Action Alternative as well as Alternatives 2 and 4 for the DLH and MM areas using an output from simulated fire behavior modeling runs conducted for the various alternatives. The simulated fire behavior modeling conducted for this project is described in the Fire and Fuels Section of Chapter 3 and the related Specialist Report. Figure 60 shows the estimated soil burn severity with existing conditions within the DLH under simulated wildfire when calibrated to the 2010 Schultz Fire burn severity assessment performed by the Schultz Burned Area Emergency Response (BAER) team. This calibration was based on the similar fuel type and weather conditions for the two areas (FWPP and the Schultz Fire burn area). A separate soil burn severity map was not generated for Alternative 3 since the proposed total treated area and type of treatments are similar enough to Alternative 2 that post-treatment fuel conditions and simulated wildfire behavior would be not be substantially different. The specific fire behavior model output used as a metric for soil burn severity was heat/unit area (HUA) expressed in units of kilojoules/m^2 (kJ/m^2). Using rules developed by the project fire ecologist, HUA values were further adjusted to account for conditional crown fire, which is a crown fire that moves through the crown of trees but is not linked to a surface fire.

HUA values corresponding to high, moderate, low, and very low/unburned soil burn severity categories were determined by adjusting the minimum HUA value for each soil burn severity category to achieve the same percentage of soil burn severities for a wildfire occurring in the untreated condition (No Action Alternative) as was mapped for the 2010 Schultz fire. Based on this, minimum HUA values for soil burn severity categories of high, moderate, low, and very low/unburned were determined to be 60,313 kJ/m^2, 8,655 kJ/m^2, and 4,594 kJ/m^2, respectively. These minimum values were then used to create soil burn severity maps for Alternatives 2 and 4 using HUA outputs from the same simulated fire conditions as were used for the No Action Alternative. This process resulted in a higher percentage of the MM area being classified as "high soil burn severity" under the No Action Alternative than for the DLH area. Though the Schultz fire with its known soil burn severity distribution, proximity to the DHL area, and similar fuel load conditions served to calibrate HUA values to soil burn severity categories for the DLH area under the No Action Alternative, a similar situation did not exist for the MM area. It is not certain that HUA values used to categorize soil burn severity for the DLH area are applicable to the MM area; a higher percentage of high soil burn severity would be expected from a wildfire burning through the MM area given the fuel load and fuel type conditions in this area. Therefore, the estimated soil burn severity used for comparison purposes in this analysis may actually be conservative.

Figure 60: Soil Burn Severity for DLH under Existing Conditions, Calibrated to the Schultz Burn Severity Assessment from the Burned Area Emergency Response (BAER) Assessment



Hydrologic Modeling

Hydrologic modeling of Schultz Creek was conducted using WildCat5, a hydrologic model for predicting total runoff and peak discharge for single rain events based on the curve number (CN) method developed by the former U.S. Soil Conservation Service (now USDA Natural Resources Conservation Service). The CN method requires the classification of soils into different hydrologic soil groups (i.e., A, B, C, and D) based on their minimum infiltration rate as well as selection of representative CNs. Soils were placed into different hydrologic soil groups (HSGs) based on soils information contained in the TES survey for the Coconino National Forest. CNs are coefficients representing the effects of land use/cover, soil type, and surface cover condition on the runoff response and generally range from a low of 25 for forested lands with soils completely covered by living or dead biomass to a high of 98 for impervious areas such as parking lots. Representative CNs for the various hydrologic soil groups (HSGs) under current conditions were initially selected from published literature (Haan, et.al., 1994) but were subsequently adjusted to generate a peak discharge similar to that identified by FEMA for the 1 percent recurrence interval event (100-year flood) for Schultz Creek (FEMA, 2010). Post-fire CNs based on soil burn severity and HSG were derived from values used for post-Schultz fire flood estimation without adjusting for slope. Fire model outputs were not available for roughly 430 acres within the Schultz Creek watershed as can be seen as uncolored areas on the soil burn severity maps. In these areas, CNs were selected to represent unburned forest conditions. Modeling runs were conducted for the 100-year precipitation event as well as a precipitation event that occurred over the area impacted by the Schultz fire on July 20, 2010[26]. This type of high-intensity, short-duration rain event is much more likely than the statistically rare 100-year event that has only a 1 percent chance of occurring in any given year. Modeling runs for the various action alternatives in the absence of wildfire were not conducted because there is no meaningful method for estimating curve numbers under the spatially varied disturbance that is typical of fuel treatments. Thinning treatments may locally alter surface cover and soil infiltration rates but these areas of disturbance are likely to be surrounded by undisturbed areas which act as buffers for absorbing runoff.

Hillslope Erosion Predictions

Post-simulated wildfire hillslope erosion predictions for untreated and treated forest conditions were made using the web-based Erosion Risk Management Tool (ERMiT) without consideration of potential Burned Area Emergency Response (BAER) treatments that would potentially be implemented following a wildfire of the size simulated. BAER treatments were not considered as there is no way to predict the type or quantity of treatments that would potentially be implemented. This on-line tool (http://forest.moscowfsl.wsu.edu/cgi-bin/fswepp/ermit/ermit.pl) was developed by the U.S. Forest Service based on Water Erosion Prediction Project (WEPP) technology specifically for predicting erosion rates on hillslopes following a wildfire (Robichaud, et. al ., 2007). This tool specifically predicts post-fire sediment delivery rates to streamcourses from rill and interrill erosion processes occurring on hillslopes that drain to these streamcourses. Hillslopes and streamcourses were delineated with ArcGIS 10.1 using a 10-meter digital elevation model. This delineation resulted in 835 separate hillslopes in the DLH area and 274 separate hillslopes in the Mormon Mountain area. ERMiT input parameters of soil texture and soil burn severity classification were derived from TES and the soil burn severity maps, respectively. ERMiT climate input data for the DLH area was derived from a weather station located at the Fort Valley Experimental Forest headquarters on State Highway 180 whereas

[26] Schultz rain event equates to the approximately 1.78 inches of rain in 45 minutes that occurred on July 20, 2010 over the Schultz Fire burn area.

climate data for the Mormon Moutain area was derived from a weather station at the Flagstaff airport. Hillslopes with surfaces mapped as rock outcrop were considered to be non-erodible whereas sediment delivery from very low/unburned hillslopes was assumed to be zero based on reported erosion rates for undisturbed forest conditions (Elliot and Robichaud, 2005).

Rather than absolute values reflecting average erosion rates for a specified period, ERMiT sediment delivery predictions are presented in probabilistic terms. For example, a sediment delivery rate based on a probability of 50 percent means that this sediment delivery rate has a 50 percent chance of being equaled or exceeded in a given year. This approach to prediction is in part, a function of the probabilities associated with various sized rainfall and associated runoff events based on a statistical analysis of historic weather records.

Timber Harvest Limitation Ratings

TES identifies timber harvest limitations as the limits to be considered when evaluating the suitability of timber harvesting by equipment use with regard to maintenance of soil productivity (Miller, et.al., 1995). Limits relate to year-round or seasonal use of equipment as the result of climate, soil characteristics, and landform. A slight rating indicates that mechanized harvesting can be performed year round with a low risk of soil productivity impairment. A moderate or severe rating directs the land manager to areas that require some measure of mitigation in order to avoid impairment of soil productivity. Timing of thinning operations can often be used to mitigate soil moisture problems. For example, thinning can be performed during frozen ground or dry conditions to minimize risk of soil compaction and rutting. Additionally, slope limitations can be established for different thinning treatments.

Affected Environment

See the Soil and Water Resources Existing Conditions section of Chapter 1 for a discussion of the current conditions for soil and hydrological resources within the project area.

Environmental Effects

For the purposes of the analysis of direct/indirect and cumulative effects, short-term effects are those lasting five years or less whereas those effects lasting longer than this are considered to be long-term effects. The time period for short-term effects is based on information from the Beaver Creek experimental watershed in northern Arizona indicating that suspended sediment concentrations in a catchment that was clear cut stabilized approximately five years following treatment (Hansen, 1965). This finding is consistent with field observations by resource specialists indicating that within approximately five years of thinning treatments, vegetative cover is restored to pre-disturbance levels (Steinke, personal communication 2013).

Direct/indirect and cumulative effects to soils, springs, wetlands, and riparian areas are analyzed within the proposed project boundary since any impact to these resources by proposed treatments would most likely occur at or in their immediate vicinity. For example, soils are most likely to be impacted by those activities that occur directly on them as opposed to activities that are distant from the soil resource. In the case of water quality, direct/indirect and cumulative effects are analyzed at the catchment scale. Catchments are drainage areas nested within larger sub-watersheds and are an appropriate analysis scale for this project as impacts to water quality from proposed vegetation treatments and past, present, and reasonably foreseeable future actions are most likely to be detectable at this scale rather than at the larger sub-watershed scale, in which catchments are nested.

Alternative 1: No Action

Soils

Direct & Indirect Effects

Under the No Action Alternative, there would be no vegetation treatments to modify stand structure in order to reduce the potential for wildfire and/or its intensity should a wildfire occur within the analysis area. The majority of the DLH and MM portions of the analysis area are classified as having a group I natural fire regime, which is generally characterized by low-severity fires replacing less than 25 percent of the dominant overstory vegetation but can include mixed-severity fires that replace up to 75 percent of the overstory.

In turn, the condition class for the majority of these areas, which reflects the extent to which current vegetation (in terms of composition and structure) departs from simulated historic vegetation reference conditions due to an absence of fire and an increase in fire return intervals for a particular natural fire regime, is condition class 3, reflecting a high departure from reference conditions. This high departure from natural (reference) conditions highlights the vulnerability of the catchments draining the analysis area to a fire that would likely greatly alter the catchment hydrologic response, rate of erosion, and sediment transport.

This alternative would not authorize ground disturbance from mechanical vegetation and prescribed fire treatment activities. As a result, there would be no risk to soil productivity from disturbance associated with these activities. Soil resources, however, would continue to be at risk from a wildfire as noted below.

Fire suppression and historic grazing combined with subsequent favorable weather conditions for pine recruitment have been identified as causative factors in the high densities of trees in southwestern ponderosa pine forests under post-European settlement conditions (Covington, et.al., 1997). The high canopy cover in these forests has reduced understory shrub and herbaceous species leading, in some cases, to monoculture stands of stunted ponderosa pines. Under the No Action Alternative, the current forest structure would remain unaltered. The density of forest overstory cover would remain higher than historic evidence suggests it was and herbaceous and shrub species would continue to be suppressed. The potential for stand-replacing fires would remain elevated. These “no action” conditions have important consequences to soil resources.

The likelihood of a stand-replacing fire under the current (no action) forest structure poses a serious risk to soil condition. Since there would be no vegetation treatments authorized under the No Action Alternative, forest soils in untreated areas would potentially be vulnerable to the effects of an uncharacteristic stand-replacing wildfire given the departure of existing forest conditions from reference conditions. Figure 61 and Figure 62 show the anticipated soil burn severity that could occur with simulated wildfire. Such a fire occurred on the Coconino National Forest in June 2010 during the Schultz Fire. The Schultz Fire burned approximately 15,000 acres with roughly 39 percent of the area classified as high burn severity and 27 percent as moderate burn severity (Higginson, 2010). These types of fires can result in large losses of soil nutrients through volatilization, mineralization, and subsequent accelerated erosion (Neary, et.al., 1999).

Soil burn severity maps for the various alternatives are presented in Figure 61 through

Figure 68. Soil burn severity categories for the various alternatives are summarized in Table 100.

Table 100: Soil Burn Severity Categories as a percentage of simulated wildfire, DLH

	Soil Burn Severity (% of total simulated fire area)			
Alternative	Very low/unburned	low	moderate	high
No Action	9	27	25	39
Alternative 2 & 3	37	41	14	8
Alternative 4	21	31	18	30

Table 101: Soil Burn Severity Categories as a percentage of simulated wildfire, MM

	Soil Burn Severity (% of total simulated fire)			
Alternative	Very low/unburned	low	moderate	high
No Action	1	15	22	62
Alternative 2	32	36	31	1
Alternative 4	37	31	16	17

Table 102 and Table 103 summarize the total predicted sediment delivery to streamcourses from hillslope erosion processes within the DLH and MM areas for the first year following simulated wildfire based on a 50 percent probability that these values would be equaled or exceeded during this first year. The column displaying the percent of sediment delivery change is a comparison of the decrease in total sediment delivery between the No Action Alternative and the three action alternatives. Because of the random nature of the rain events that drive erosion, the values presented in these tables should not be viewed as absolutes but rather, should be viewed as relative values allowing a comparison between the alternatives.

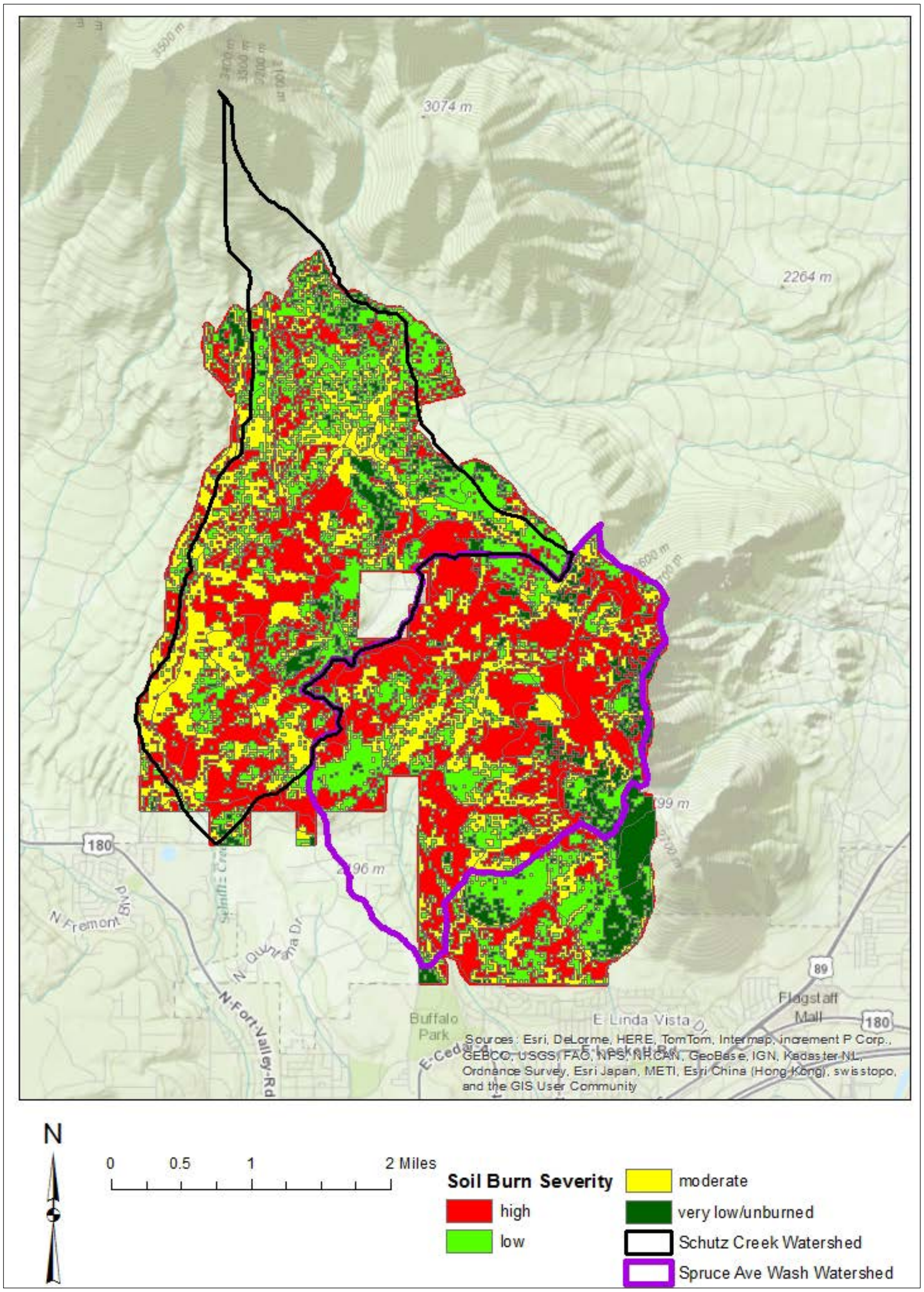
Table 102: Summary of total sediment delivered to stream networks in the DLH area during the first year following simulated wildfire

Alternative	Total Sediment Delivery (tons)	% Sediment Delivery Change
No Action	14,912	0
Alternative 2 & 3	8,277	-44
Alternative 4	12,977	-13

Table 103: Summary of total sediment delivered to stream networks in the MM area during the first year following simulated wildfire

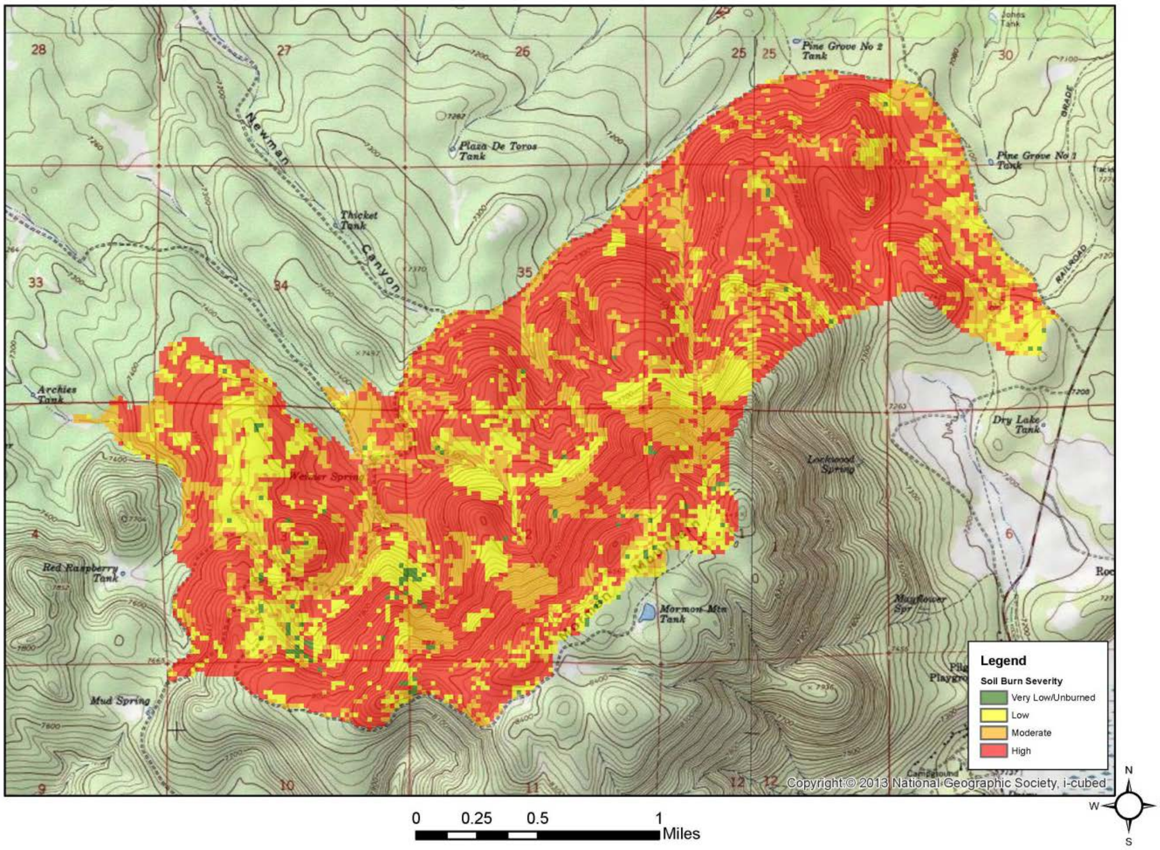
Alternative	Total Sediment Delivery (tons)	% Sediment Delivery Change
No Action	2,445	0
Alternative 2 & 3	1,432	-41
Alternative 4	1,551	-37

Figure 61: Soil Burn Severity Map for DLH, No Action Alternative with Simulated Wildfire



In addition, adverse impacts to soil hydrologic functioning (i.e., reduced infiltration through consumption of soil organic matter, loss of soil structure, and formation of soil hydrophobicity) can occur (Neary, et.al., 1999).

Figure 62: Soil Burn Severity Map for MM, No Action Alternative with Simulated Wildfire



Cumulative Effects

Other past, present, and reasonably foreseeable future actions that are likely to cause ground disturbance and therefore contribute to cumulative impacts to soil and water resources generally include timber harvesting, recreation activities, and grazing. Though not a mode of ground disturbance, climate change may also be considered a cumulative effect with potential impacts to soil and water resources. Specifically, the effects to soil and water resources associated with the following projects/activities were considered in the cumulative effects analysis:

- Mountain Elden/Dry Lake Hills (MEDL) Recreation Planning Project
- Eastside Fuels Reduction Project
- Four Forest Restoration Initiative
- Jack Smith Schultz Fuels Reduction Project
- General dispersed recreation activities
- Grazing
- Climate Change

In addition of those direct/indirect effects to soils from the No Action Alternative, particularly, the continuation of forest conditions conducive to an uncharacteristic wildfire, the following cumulative effects to soils from past, present, and reasonably foreseeable future projects would potentially occur.

The MEDL Recreation Planning Project currently proposes roughly 30 miles of new or re-located trails; consolidation, re-location, or expansion of existing trailheads; construction of a hang glider launch pad; and establishment of new trailheads with associated parking areas either within or immediately adjacent to the analysis area. This project would address increasing demand for recreational opportunities in the Flagstaff area by providing a sustainable trail system to accommodate multiple user groups including hikers, mountain bikers, horseback riders, climbers, and hang gliders. Even though there would be additional impacts to soils associated with new trail construction, new or expanded trailhead parking areas, and a hang glider launch pad, the project would likely have an overall positive impact on soils since it would re-route those trails that cannot be adequately drained because of their position on the landscape, it would include the decommissioning of non-system trails and roads, and it would consolidate several trailheads. Those portions of non-system trails that meet Forest Service trail construction standards would be incorporated into the system of new trails thereby further reducing new disturbance to soils.

The Eastside Fuels Reduction Project (2009) is an ongoing effort to reduce hazardous fuels around the base of Mt Elden involving approximately 226 acres of hand thinning, 151 acres of ground-based mechanical thinning on slopes less than 40 percent, and 56 acres of burn only (prescribed fire) treatment within the DLH area. The Jack Smith Schultz Fuels Reduction Project (2008), located within the DLH area, is a hazardous fuels reduction project in the DLH area that includes burn only treatments, mechanized ground-based harvesting on slopes less than 40 percent, and hand-thinning treatments. Potentially beginning in 2014, a 837 acre portion of the DLH area would be treated as part of the future Orion Timber Sale included within the Jack Smith Schultz Fuels Reduction Project. This area would be treated by ground-based harvesting on slopes less than 40 percent with the effects to soils as described in the section on effects common to all action alternatives. Mechanized, ground-based tinning and prescribed fire treatments would cause disturbances to soils with erosion rates likely exceeding rates under undisturbed forest conditions for the short term; however, similar design features as proposed for action alternatives would be implemented minimizing the amount of disturbance to soils. It is important to note that some amount of disturbance to soils can be beneficial as it promotes the spread of herbaceous cover that can improve nutrient cycling and soil stability. The reduction in hazardous fuels would also reduce the likelihood of an uncharacteristic wildfire with its consequent impacts to forest soils.

There are no past, present, or reasonably foreseeable future vegetation treatments within the MM area, but recreation activities, including but not limited to hiking, mountain biking, and hunting have occurred and would continue to occur within this portion of the analysis area. These activities affect soils because they typically require a network of roads and trails resulting in the reduction or elimination of vegetative cover and compaction of soils, both of which can lead to accelerated erosion.

Roads open to the public in the MM area are typically only seasonally accessible because of snow accumulation. Roughly one-third of a mile of the Arizona Trail crosses the northeastern corner of the project area. Except in localized segments, these roads are not likely to be experiencing accelerated erosion because of low or no traffic and limited maintenance both of which are factors that affect road erosion rates (Grace and Clinton, 2007). Under low or no traffic conditions, road surfaces may become armored, reducing erosion rates by 70 to 80 percent (Elliot, et.al. 2009).

The Peaks Allotment overlaps the DLH-portion of the project area and includes portions of two grazing pastures; Freidlein Prairie and Schultz. Neither pasture has been grazed in over ten years and are deferred from livestock use indefinitely per the August 19, 2010 Decision Notice/FONSI for the Peaks Allotment.

Two grazing allotments, Tinny Springs and Picket Lake/Padre Canyon overlap the MM-portion of the project area. These allotments are grazed from June 1 through October 31, in the case of Tinny Springs, and June 1 through September 30, in the case of Picket Lake/Padre Canyon. Grazing can affect soils through removal of vegetation and compaction of soils, however; these effects are often temporary with recovery of vegetation following precipitation and recovery of soil compaction through natural soil disturbance mechanisms such as heaving of soils freeze/thaw cycles and burrowing of animals. The transient disturbance to soils from cattle grazing is not expected to result in negative impacts to soil productivity even when combined with other disturbances to soils as discussed in this section.

The extent to which climate change impacts soil productivity would be largely governed by the impact of climate change on vegetation structure and composition. Vegetative cover fluctuates naturally in response to inter-annual and longer climate variability. Climate change in the North American southwest is predicted to lead to decreased winter precipitation throughout the current century (Seager and Vecchi, 2010). This decline in winter precipitation could lead to a decrease in herbaceous cover dependent on winter precipitation. Although winter precipitation is important for annuals and cool season grasses as well as replenishment of soil moisture, herbaceous productivity in the southwest is primarily controlled by summer precipitation delivered by the North American monsoon (NAM) (McCollum, et.al., 2011). The effect of climate change on the NAM, which accounts for roughly half the precipitation in the region, is uncertain, however; recent research suggests a delay in the onset of the NAM with no change in total precipitation (http://www.ldeo.columbia.edu/res/div/ocp/glodech/research10futureANM.html). A delay in NAM would increase the length of the fire season potentially leading to more severe and widespread forest fires. It is this potential effect of climate change that would pose the greatest threat to soil productivity likely overwhelming any other cumulative effects to soils within the project area. Under the No Action Alternative, risks to soils from climate change-induced increases to fire severity and size would not be reduced.

Water Resources

Direct & Indirect Effects

Under the No Action Alternative, water resources would not be affected by the proposed treatments included in the action alternatives as no actions would be authorized. However water resources would potentially be affected by the failure to reduce current fuel load conditions that are conducive to an uncharacteristic stand-replacing wildfire. In particular, the potential for a wildfire similar to the Schulz Fire that occurred in 2010 would still exist. This wildfire resulted in an increase in the amount of rainfall converted to runoff producing widespread flooding, incision of existing drainages, erosion of hillslopes, and mobilization of sediment. Post-fire peak discharges were estimated to be one to two orders of magnitude larger than those produced by similar pre-fire rainfall events (Neary, et.al. 2012). If a similar fire were to occur in the DLH-portion of the analysis area, flooding would likely occur in heavily populated portions of the City of Flagstaff along the Rio De Flag and Spruce Avenue Wash/Switzer Canyon drainages. In particular, the Rio De Flag has been the subject of a feasibility study to improve flood protection along this drainage as the “economic, social, environmental, and regional impacts and damages from a large flood event would be severe and devastating to the community” (ACOE, 2000). The predicted Schultz Creek peak discharge under the No Action Alternative with simulated wildfire was roughly 4.3 times the predicted 100-year peak discharge under current conditions (i.e., no fuel treatments or wildfire) (Table 104).

Table 104: Predicted Peak Discharges for Schultz Creek at Mt. Elden Lookout Road

Alternative	100-year Peak Discharge[27] (cfs)	Schultz Rain Event Peak Discharge[28] (cfs)
No Action, Current Conditions (no wildfire)	474	222
No Action, Simulated Wildfire	2045	2014
Alternative 2 & 3 Simulated Wildfire	1184	804
Alternative 4, Simulated Wildfire	1607	1409

An uncharacteristic stand-replacing wildfire in the MM-portion of the analysis area would potentially impact water quality in Upper Lake Mary, the principal source of surface water for the City of Flagstaff. A comparison of the amount of sediment that could be delivered to streamcourses from hillslope erosion within a one year period following ground-based mechanized thinning treatments, thinning treatments combined with prescribed fire, and wildfire was simulated by Elliot and Robichaud (2001) using Disturbed WEPP, an Internet-based computer program designed to predict runoff and rill/interrill erosion from undisturbed forests, forest fires (prescribed and wild), forests disturbed by timber harvesting, and rangelands under various cover conditions. Sediment yield was predicted to be 0.033 tons/hectare for first year following thinning treatments alone, 0.11 tons/hectare for thinning combined with prescribed fire, and 8.93 tons/hectare for wildfire. These simulation results highlight the increase in erosion following wildfire versus that from vegetation treatment. When compared to natural rates of erosion in forest environments, which have been reported to be less than 0.11 tons/hectare (Elliot, et.al., 1999), it can be seen that thinning or thinning combined with prescribed fire is not likely to increase the amount of sediment reaching streamcourses, but that wildfire may do so by several orders of magnitude.

Cumulative Effects

The cumulative effects of vegetation treatment activities associated with the Jack Smith Schultz and Eastside Fuels Reduction projects as well as the MEDL Recreation Planning project may lead to short-term increases in the delivery of sediment to streamcourses within the catchments of the DLH area, however, these increases are likely to be small and not detectable at catchment outlets given the ephemeral nature of flow in these streamcourses, the spatial and temporal aspects of

[27] 100-year storm equates to 4.98 inches of rain in a single, 24-hour day. The following rainfall distribution pattern used to simulate monsoonal patterns: 60% of the rainfall occurs within about 30% of the 24-hour day

[28] Schultz rain event equates to the approximately 1.78 inches of rain in 45 minutes that occurred July 20, 2010 over the Schultz Fire burn area.

disturbance, and the length of time, measured in years to decades, it takes for sediment to be routed through a forest streamcourse (see Table 105; Elliot and Robichaud, 2005). Typical erosion and sediment delivery rates for forest disturbances are presented below. Also, recovery from even extreme disturbance events in forests, even wildfire, is typically rapid with rates of erosion reported to drop by up to two orders of magnitude in the second year following a wildfire and returning to natural (undisturbed) rates in the fourth year following a wildfire (Robichaud and Brown, 1999). Because disturbance activities would be distributed in both space and time rather than simultaneously and concentrated, the cumulative effects to water quality are predicted to be insignificant.

Table 105: Predicted rates of erosion (from Elliot and Robichaud, 2005)

Activity	**Erosion Disturbance Rate**	**Time between disturbances**	**Average annual sediment delivery**
	Mg/ha	*years*	*Mg/ha*
Wildfire	6.0	40	0.15
Prescribed fire	0.02	20	0.001
Thinning or logging	0.10	20	0.005
Road segments	0.125	1	0.125
(assuming 2.5% of watershed)			

Within the catchments draining the MM area, cumulative effects to water quality could occur by implementation of mechanical treatments under the Four Forests Restoration Initiative (4FRI) combined with those from the road system within the catchments. It is not predicted that grazing within the catchments would negatively impact water quality. Since roads within the catchments are only seasonally accessible with low traffic conditions and low maintenance activities, two conditions that strongly influence rates of erosion on forested roads (Grace and Clinton, 2005), combined with streamcourses that flow only intermittently mainly following spring snowmelt, the existing road system is not likely to be contributing significantly to water quality degradation in Lake Mary. Vegetation treatment activities within the catchments associated with 4FRI would likely occur over a period of years, resulting in temporally varied disturbance to forest soils with minimal sediment delivery to streamcourses within any given year. The temporary disturbance to forest soils with short-term increases in erosion rates and delivery of sediment to streamcourses contrasts with the potential impacts to the water quality of Upper Lake Mary from an uncharacteristic wildfire that would dramatically increase rates of erosion and the delivery of sediment and ash to this water body.

Effects Common to All Action Alternatives

Soils

Direct and Indirect Effects

The three action alternatives all include burn only treatments, hand thinning treatments, and mechanized thinning treatments on slopes less than 40 percent. In addition, prescribed burning would be performed after the various thinning treatments. This section provides an overview of the potential effects to soils and water resources from these treatments.

Hand Thinning

A minor amount of hand thinning using chainsaws and hand piling of downed material with no yarding of felled timber would be implemented in the various action alternatives. Hand thinning would result in minimal impacts to soils since no construction of temporary roads would be needed, and heavy machines would not be used for felling and transporting of harvested timber. Soil disturbance from hand thinning operations is generally considered negligible (Robichaud, et.al. 2005; Berg and Azuma, 2010). No long-term loss of soil productivity nor accelerated erosion would be expected to occur from hand thinning and hand piling operations.

Ground-based Mechanized Thinning

The majority of the analysis area (roughly 55 percent for Alternatives 2 and 3 and 50 percent for Alternative 4) would be treated by mechanized, ground-based harvesting methods on slopes less than 40 percent. Ground-based harvesting involves the use of either wheeled or tracked machinery in contact with the ground surface to both cut trees and remove them from the harvest area to landings in a process called "skidding." Ground-based harvesting systems include whole tree harvesting systems in which trees are felled and the entire tree is skidded from the harvest area to landings, where the trees are further processed by delimbing and bucking (i.e., cutting the trees to specific lengths) and cut-to-length systems in which trees are felled and processed at the stump with transport of processed logs to landings. In whole tree harvesting, trees are generally felled and bunched using a tracked or rubber-tired feller-buncher and tree bunches are skidded (i.e., dragged with crowns in contact with the ground) along designated skid trails to landings. Skidding is generally accomplished using tracked or rubber-tired skidders. In cut-to-length systems, trees are generally felled using a harvester equipped with a head that allows both cutting and processing of trees. Logs are then transported to landings using a forwarder that carries the logs fully suspended from the ground in a trailer-type fashion. Occasionally, harvesting and forwarding is accomplished with a single piece of equipment referred to as a "harwarder." However this type of equipment is rare. There are various types of harvesters including trackhoes fitted with processing heads as well as multi-wheeled machines that are capable of operating on slopes exceeding 40 percent ("Forest Operations Equipment," retrieved May 22, 2014).

Ground-based mechanized thinning causes disturbance to soils including compaction, displacement of surface soil, rutting, and exposure of bare mineral soil attributable mainly to the network of temporary roads, skid trails, and landings needed to accomplish thinning. These effects have the potential to alter soil productivity, as well as surface runoff and erosion rates, which are normally very low under undisturbed forest conditions (MacDonald and Stednick, 2003). In turn, changes in surface runoff and erosion may have an effect on water quality primarily through increased sediment delivery to stream courses. Despite the use of mechanized equipment for this purpose, the actual felling of trees causes only minor disturbance to soils (MacDonald and Stednick, 2003) and will not be discussed further.

Compaction

Compaction is the process by which soil particles are rearranged resulting in a decrease in void space and a corresponding increase in bulk density (Miller, 2004). Soils are compacted by repeated passes of mechanical equipment over the forest floor along the designated road and skid trail system and landings established to facilitate harvesting, processing, and transport of logs. The degree of compaction is a function of soil characteristics, soil moisture content, number of machine passes over the soil, and pressure exerted by the machinery. Soils with water content just under field capacity (i.e., the water remaining in soil after gravity drainage) are most susceptible to compaction whereas soils with higher water content are susceptible to displacement generally observed as rutting of the soil (Miller, 2004). Soil compaction may impact soil productivity by decreasing soil macroporosity, leading to reduced water infiltration and gas exchange important for soil biological activity and oxygen uptake by roots (Han, et.al. 2009). Soil compaction may also impact soil productivity by increasing the resistance of soil to root penetration thereby limiting root growth (Lacey and Ryan, 2000). Reduced infiltration rates attributable to soil compaction may lead to increased runoff and accelerated soil erosion with potential impacts to water quality and soil productivity.

Soil Displacement
Displacement of soil typically occurs when soil moisture is above field capacity and the presence of water-filled voids in the soil prevents further compaction by heavy equipment but causes soil to be displaced forming ruts. The displacement of soil can expose less productive soil horizons and/or those with a different chemistry potentially altering site productivity. In addition, the formation of ruts can concentrate runoff increasing its velocity and capacity to detach and transport soil particles. Ruts may also disrupt natural runoff patterns from hillslopes.

Soil Exposure
The exposure of bare mineral soil increases the susceptibility of soil to detachment from raindrop impact and sheetflow potentially contributing to accelerated erosion on hillslopes.

Temporary Road Construction

The exposure of bare mineral soil is most pronounced on temporary roads and the road system needed to conduct logging operations has been identified as far overshadowing that from other aspects of treatment operations (Rice, et.al. 1972; Megahan and Kidd, 1972). Temporary roads are those that are constructed during timber harvesting to facilitate access to timber stands and that are rehabilitated after harvesting by restoring the roadbed to its pre-disturbance condition to the extent possible. Some of the proposed temporary roads would be constructed on existing road prisms that were previous Forest Service system roads. Alternatives 2 and 3 are identical in terms of area treated by thinning but in Alternative 3, helicopter and forwarder yarding replace cable yarding. Because of the difference in yarding methods between the two alternatives, the proposed temporary road distance differs by approximately 5.81 miles total (4.7 fewer miles in the DLH and 1.07 fewer miles on MM in Alternative 3). Alternative 4 includes less treated acres than Alternatives 2 and 3 and therefore, less distance of temporary roads.

Soil Burn Severity

The following figures and tables show the estimated soil burn severity for the action alternatives, with the red color as high burn severity, yellow as moderate burn severity, light green as low burn severity, and dark green as very low/unburned. Figure 65 and Figure 66 show the soil burn severity modeled after the treatments proposed in Alternatives 2, 3 and 4 compared to the Schultz Fire burn severity.

Table 102 and Table 103 summarize the total sediment estimated to be delivered to stream networks in the DLH and MM areas during the first year following a simulated wildfire. Alternatives 2 and 3 result in the lowest sediment delivery in both areas, approximately 44 percent less than the No Action Alternative in DLH and 41 percent less in MM. Alternative 4 would result in approximately 13 percent less sediment delivery than the No Action Alternative in DLH and 37 percent less in MM. These results suggest that thinning treatments proposed under

Alternatives 2 and 3 would provide the greatest benefits in terms of mitigating the potential threat from erosion associated with a wildfire.

Figure 63: Soil Burn Severity Map for DLH with Simulated Wildfire, Alternatives 2 & 3

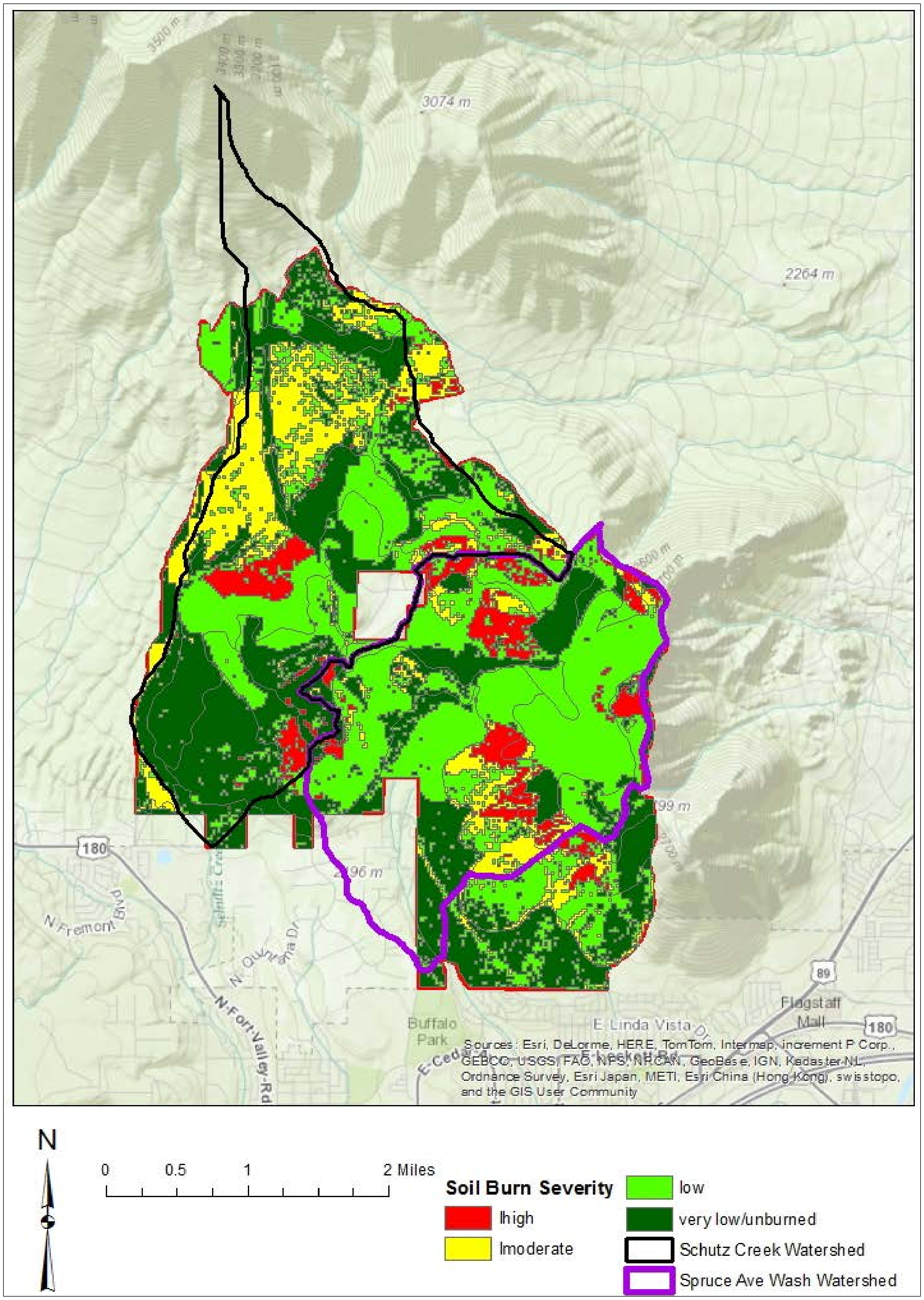


Figure 64: Soil Burn Severity Map for DLH with Simulated Wildfire, Alternative 4

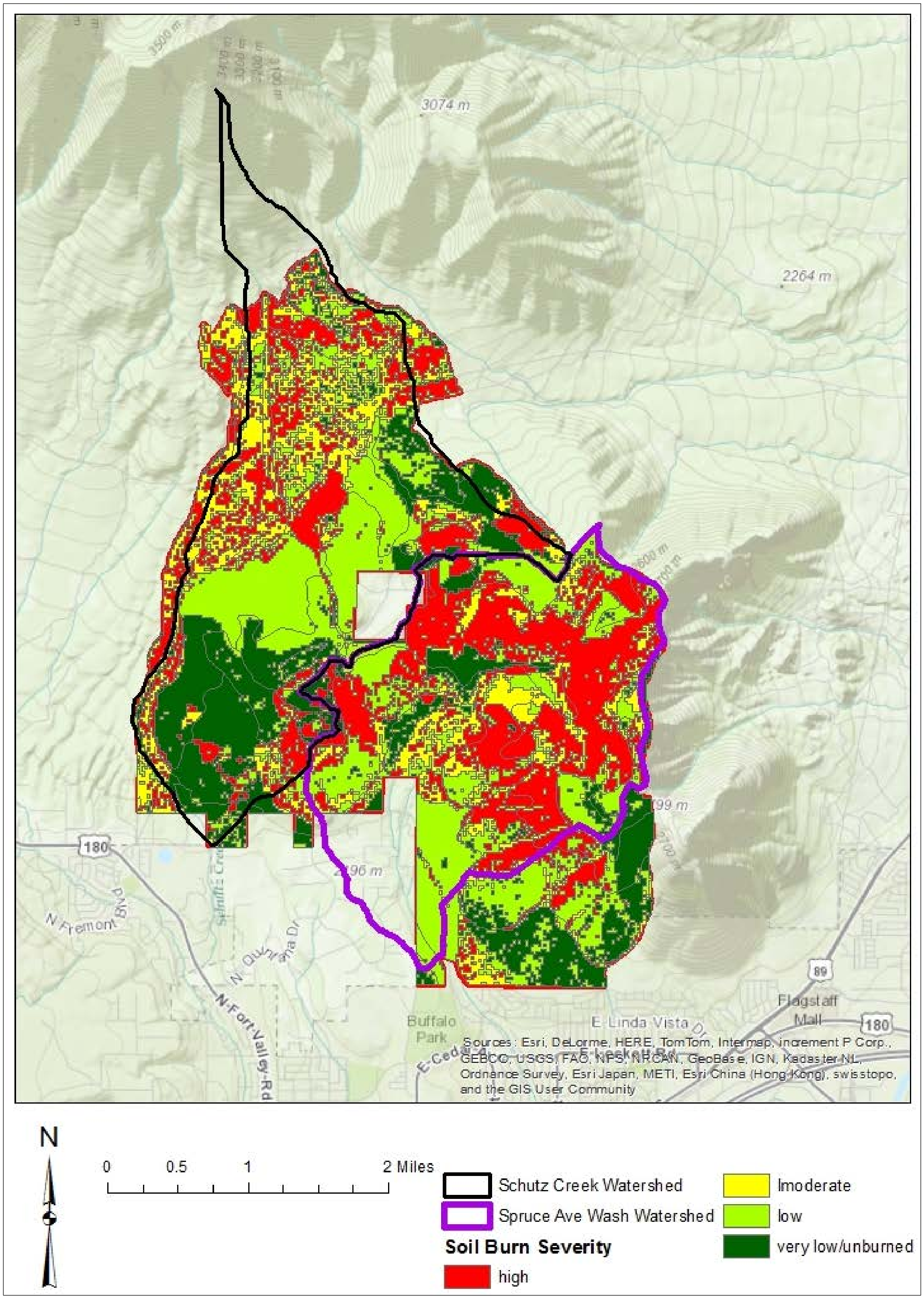


Figure 65: Soil burn severity modeled after Alternative 2 & 3 treatments, compared to the Schultz Fire burn severity

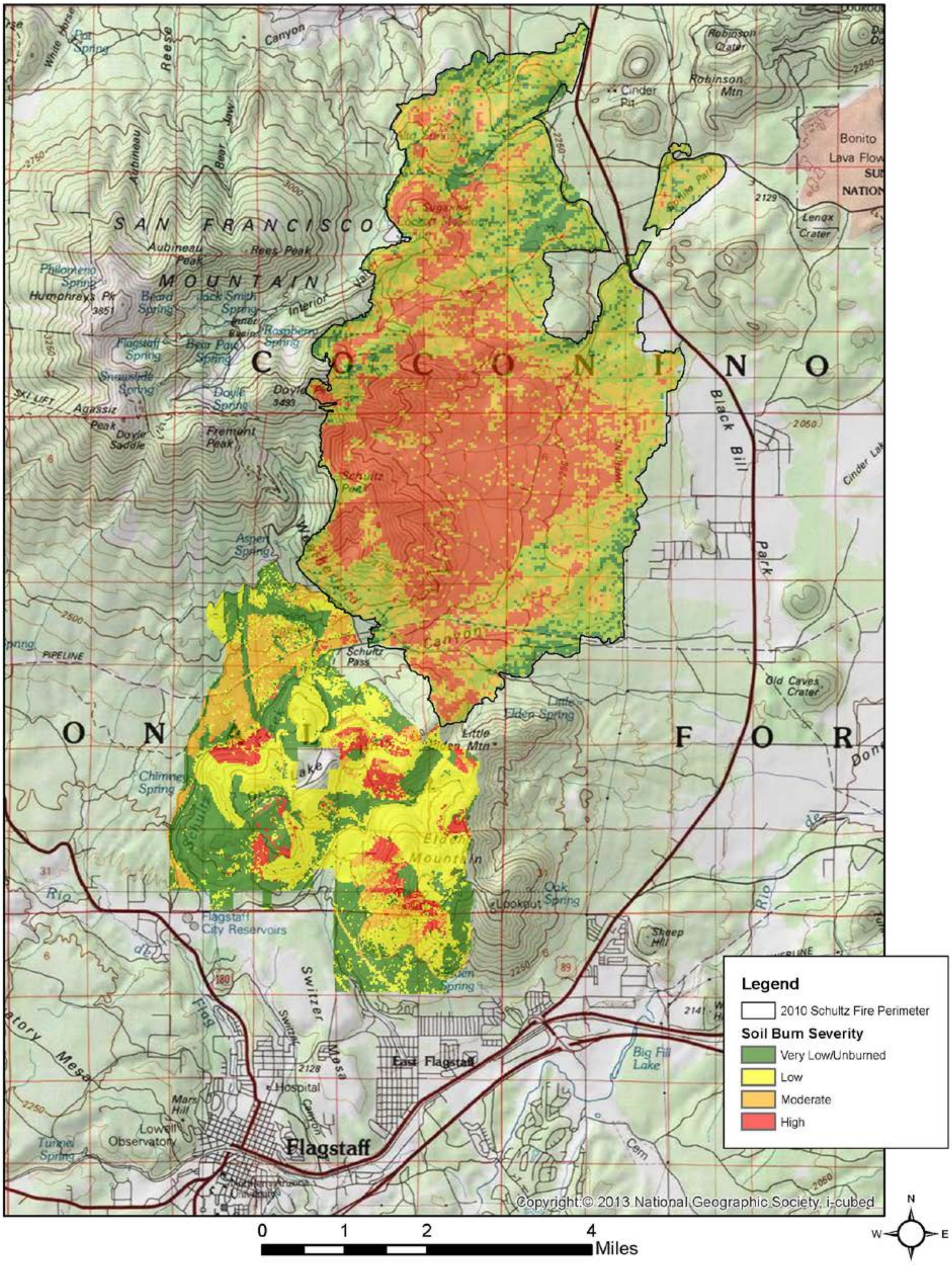


Figure 66: Soil burn severity modeled after Alternative 4 treatments, compared to the Schultz Fire burn severity

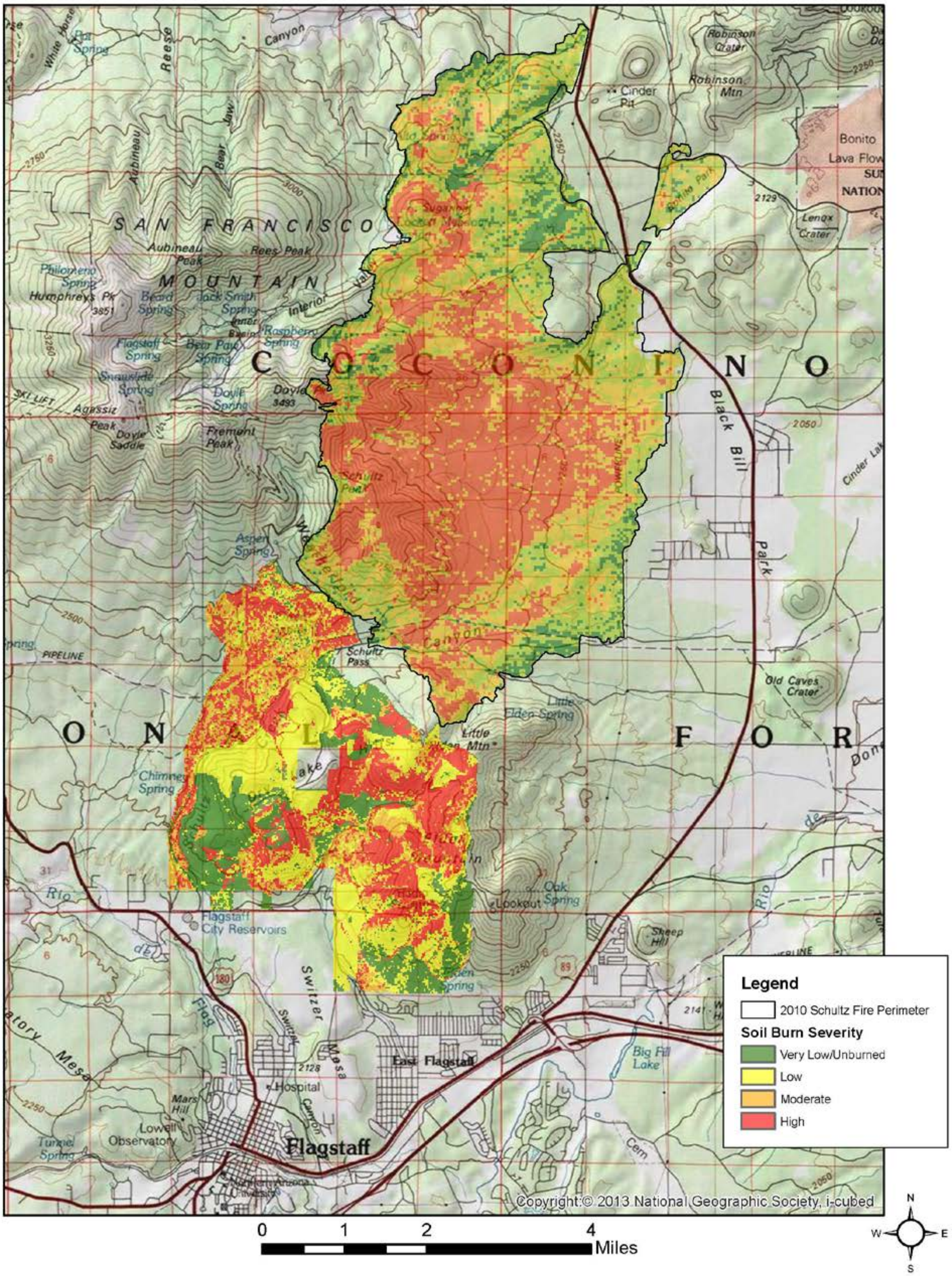


Figure 67: Soil Burn Severity Map for Alternatives 2 & 3, MM

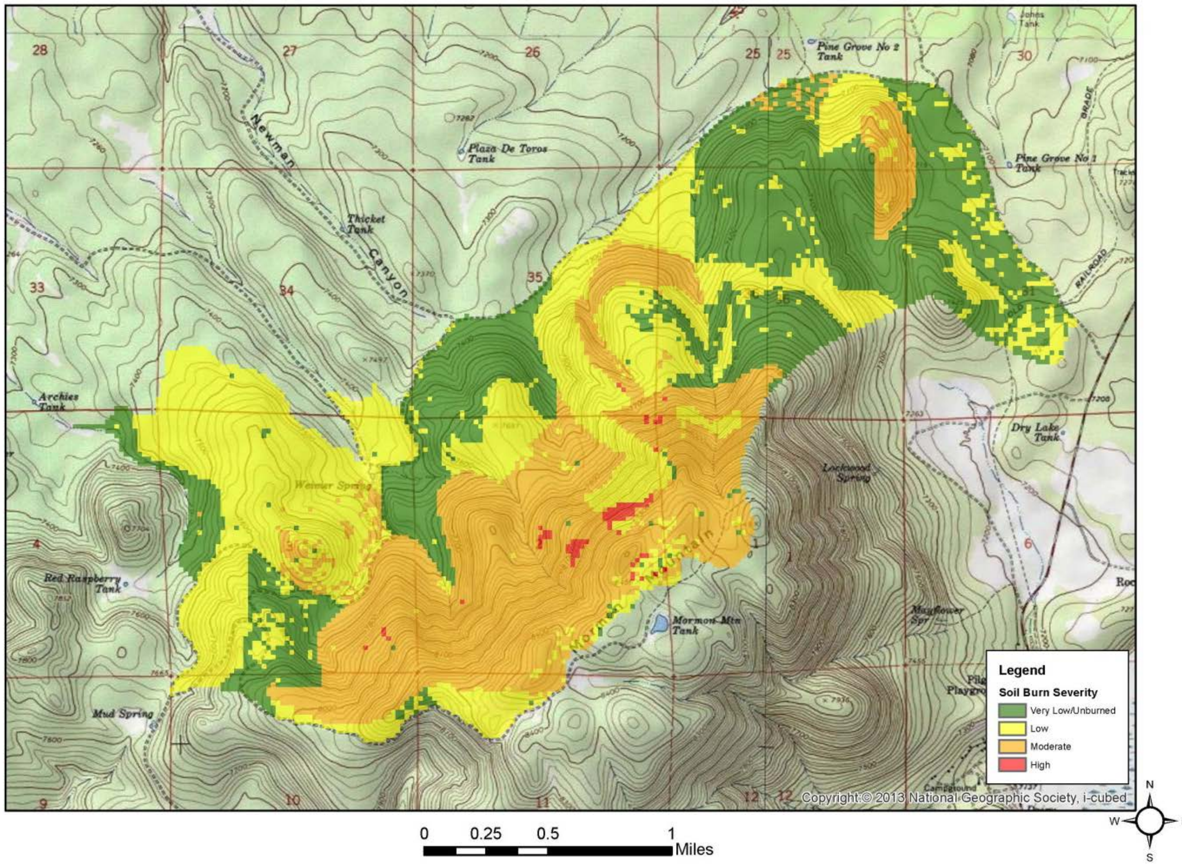
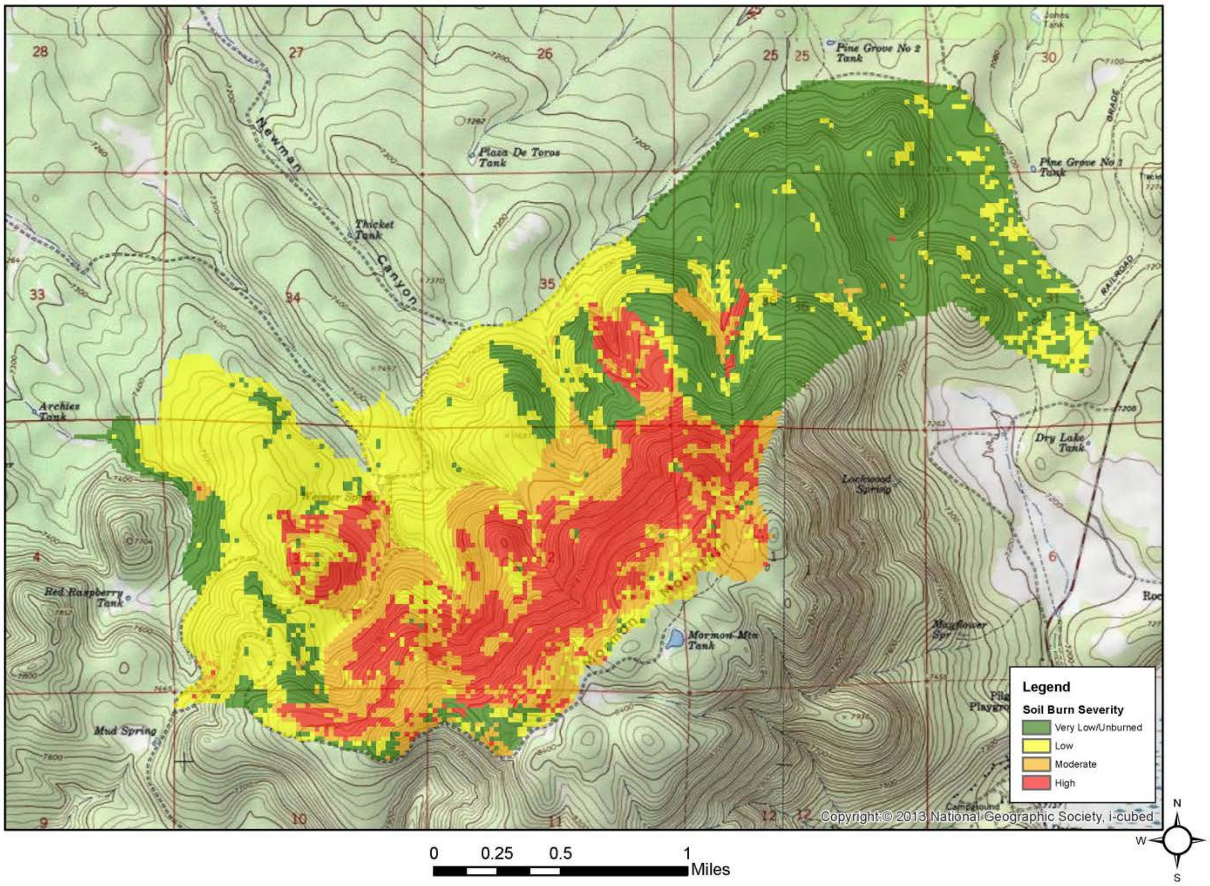


Figure 68: Soil Burn Severity Map for Alternative 4, MM



Broadcast Burning

Fuel treatments using prescribed fire are proposed under the action alternatives either as “burn only” treatments (i.e. no other method of treatment) or following treatment in areas where it is necessary to reduce the fuel load through either hand or mechanical thinning prior to the introduction of fire. In both cases, the effects are anticipated to be similar since prescribed fire would not likely be introduced for several years following mechanical treatment, when enough fine fuel has accumulated to carry a fire.

The conditions under which prescribed burning would be conducted are generally characterized by high relative humidity, low air temperatures, low fuel loadings, and high fuel moisture. These conditions typically produce low burn severity in which surface litter is only partially consumed. In addition, the timing of controlled burns is such that burns are conducted during fall or spring, when lower ambient temperatures minimize surface litter consumption. Prescribed fires, however, do produce spatial variations in burn severity ranging from high to unburned depending on surface fuel loads. This spatial variability leads to varying runoff and erosion rates (Robichaud, et.al., 2010).

In areas of low to moderate soil burn severitity, only a portion of the surface organic matter is consumed leaving adequate soil cover over much of the burned area. In general, prescribed fire does not cause excessive erosion or sediment transport since soil cover is retained in a discontinuous pattern across the landscape. Because of this, long-term adverse impact to soils are not expected from prescribed fire activities. This conclusion is supported by controlled burning experiments conducted on the Fort Apache Reservation located in the White Mountains of northeastern Arizona, which indicated minimal soil erosion following controlled burning (Weaver, 1952; Cooper, 1961). Cooper (1961) evaluated post-burn erosion on a 35 percent hillslope in the White Mountains and concluded that accelerated erosion attributable to controlled burning could not be considered severe and that the soil appeared to be stabilized within a year of treatment. It was also noted that eroded material was only moved a short distance down slope. Conversely, prescribed burning would be expected to have a long-term benefit to soil resources by reducing the build-up of fuels, and restoring soil nutrient cyling through reduction of overtstory and encouragement of herbaceous cover.

Pile Burning

Burning of slash piles has been shown to negatively affect soil biotic and chemical properties due to intense soil heating (Korb et al, 2004 and Seymour and Tecle, 2004). It can result in soil sterilization, increased erosion risk and an increased risk of invasive and noxious weeds that displace native vegetation. Pile burning sites would constitute a very small portion of the project area (i.e., less than 5 percent). Monitoring of these sites for the presence of invasive or noxious weeds following pile burning, and treatment of any infestations found would mitigate most adverse effects to soils caused by pile burning of slash (see the Invasive Plant Species Specialist Report for more information).

Best Management Practices

A number of best management practices (BMPs) would be employed to protect soil resources during vegetation treatments. BMPs that would be implemented for all action alternatives are identified in the design features section. These BMPs protect soil and water resources by:

1) Minimizing the amount of disturbance to soils through measures such as designation of skid trails and curtailment of mechanical vegetation treatment activities during wet weather conditions

2) Preventing concentrated flow through use of drainage measures (i.e., water bars, rolling dips) on such features as temporary roads, skid trails, and firelines

3) Protecting stream courses and wetlands through such means as limiting the types of activities that can occur in or adjacent to them and establishing buffers or filter strips around those water bodies designated as Aquatic Management Zones (AMZs) in which disturbance is minimized.

With implementation of applicable BMPs, most adverse effects to soils and water reources would be minimized or mitigated. Additionally, natural disturbance of soils caused by seasonal wetting and drying, freezing and thawing, and soil organism activity would naturally ameliorate some adverse effects to soils caused by the action alternatives. Although disturbance of soils during thinning operations would be minimized through the use of BMPs, total avoidance would be neither feasible nor desirable since some amount of disturbance may be beneficial or necessary for seed bed preparation and for the establishment of herbaceous plants that may be inhibited by thick accumulations of forest litter.

Cumulative Effects

The actions described in the No Action Alternative section are the same actions that would contribute to cumulative effects for the action alternatives. Because the various soil disturbing activities would be distributed through time and space within the analysis area, they would not likely have an overall long term negative effect on soils. Rather, the combined effects of the past, present, and reasonably foreseeable vegetation treatments along with the treatments proposed under the various action alternatives would have long-term benefits to soils by reducing the risk to soils from an uncharacteristic wildfire, and by improving nutrient cycling through the creation of conditions favorable for return of herbaceous cover in areas where increased pine density has reduced this cover to near zero.

In addition, the proposed decommissioning of 4.19 miles of roads in the DLH under the action alternatives combined with decommissioning of roads and trails under the future MEDL Recreation Planning project would have long-term benefits to soils by creating conditions favorable for the recovery of vegetation in these areas.

Water Resources

Direct & Indirect Effects

Water Yield

The United States Geological Survey (USGS) defines water yield as “the runoff from the drainage basin, including ground-water outflow that appears in the stream plus ground-water outflow that bypasses the gaging station and leaves the basin underground” (from: http://water.usgs.gov/wsc/glossary.html). In ungaged drainage basins, such as those that occur in the project area, annual surface runoff is frequently estimated using a water balance approach whereby surface runoff is the difference between precipitation and evapotranspiration (i.e., the combined losses of water from a system via evaporation and transpiration) plus any changes in soil moisture and groundwater storage (MacDonald and Stednick, 2003). Since forest thinning generally results in a reduction in evapotranspiration, it could, theoretically, produce a change in surface runoff. MacDonald and Stednick (2003), however, note that the large variation in the hydrologic effects of forest management activities suggest that one can find studies either supporting or refuting this hydrologic response to thinning. This variable response reflects the complex interactions of climate; topography; pre- and post-treatment forest structure, composition, and density; geology; aspect and other variables on the rainfall/runoff response. Perhaps the best summary of the runoff response to thinning in forested environments is provided by Robichaud, et.al. (2010) in which it was concluded that “no measurable increase in runoff can be expected from thinning operations that remove less than 15 percent of the forest cover or in areas with less than 18 inches (450 mm) of annual precipitation. Since evapotranspiration rapidly recovers with vegetative regrowth in partially thinned areas, any increase in runoff due to thinning operations is likely to persist for no more than 5 to 10 years.”

Studies conducted in the Beaver Creek Experimental Watershed located south of the analysis area along the Mogollon Rim at a slightly lower elevation provide local evidence for increased runoff from forest thinning. Clearcut thinning of a ponderosa pine-dominated catchment within the experimental watershed resulted in an approximately 30 percent increase in annual water yield for a period of seven years, after which water yield became statistically insignificant (Lopes, et.al. 2001). Strip thinning of a second ponderosa pine-dominated watershed with an overall basal area reduction of 57 percent resulted in only a 20 percent increase in water yield, lasting for only four years following treatment.

Under Alternatives 2 and 3 in the DLH-portion of the project area, thinning treatments are proposed in roughly 5,960 acres within the portions of Schultz Creek and Spruce Avenue drainages above Mt Elden Road and above the Forest Service boundary at Spruce Avenue Wash, respectively. These two drainage areas combined encompass roughly 6,890 acres. Thinning treatments would result in an approximately 45 percent reduction in basal area within the treated portions of the watersheds or a roughly 39 percent overall reduction in basal area within the combined drainages. This reduction in forest density may be sufficient to increase the quantity of precipitation that is converted to runoff in these drainage areas depending largely on post-thinning precipitation. Based on streamflow responses to thinning in ponderosa pine drainages within the Beaver Creek watershed, the increase in water yield is likely to be ephemeral, lasting perhaps four to seven years after thinning.

The predicted peak discharge for Alternatives 2 and 3 with simulated wildfire was roughly 2.5 times the predicted 100-year peak discharge under current conditions, whereas the predicted peak discharge for Alternative 4 with simulated wildfire was roughly 3.4 times the predicted 100-year peak discharge under current conditions (Table 105). These results suggest that thinning treatments proposed under alternative 2 provide the greatest benefits in terms of mitigating the potential threat from flooding associated with a wildfire. Although hydrologic modeling was not conducted for Spruce Avenue Wash, which drains the eastern portion of the project area, the conclusions would likely be similar based on the difference in soil burn severities under the various alternatives. The results shown in Table 102 suggest that thinning treatments proposed under Alternative 2 and 3 provide the greatest benefits in terms of mitigating the potential threat from erosion associated with a wildfire.

Thinning treatments on approximately 3,392 acres are proposed in Alternative 4 with an estimated overall reduction in basal area of 22 percent within the combined drainages. This reduction in basal area may produce a slight ephemeral increase in water yield. Treated areas within the MM-portion of the project area are mostly within two drainage basins with outlets at Upper Lake Mary: an unnamed drainage basin encompassing roughly 4,330 acres, and Newman Canyon drainage basin, encompassing roughly 14,234 acres. The limited area of treatment within Newman Canyon Basin (approximately 1,300 acres) suggests that thinning treatments would not likely influence water yield at the Newman Canyon drainage basin scale. Since thinning would encompass a larger portion of the unnamed basin (approximately 39 percent) with an estimated overall basin-wide reduction in basal area of 18 percent, there may be a slight ephemeral increase in water yield at the drainage basin scale.

Water Quality

Whereas the direct and indirect effects of the action alternatives on soil resources are largely concerned with on-site impacts to soils that reduce productivity, the direct and indirect effects to water quality are largely concerned with the movement of sediment from hillslopes to stream courses.

The potential effects of the various action alternatives on water quality are related to the extent to which disturbance from the various treatment methods effect hillslope erosion and whether mobilized sediment would reach streamcourses. Hillslope erosion depends on such factors as amount of soil exposed, changes to infiltration rates, slope steepness, type and depth of soil, and the nature of precipitation (i.e., type and intensity) (MacDonald and Stednick, 2003). The movement of sediment from actively eroding hillslope areas to streamcourses is dependent on these same factors plus the spatial aspects of disturbance (i.e., whether disturbed areas are surrounded by relatively undisturbed areas, and the proximity of disturbance to streamcourses), and the types of post-treatment mitigation methods or BMPs that are applied.

Using Disturbed WEPP, Elliot and Robichaud (2001) compared rates of sediment yield (i.e., the amount of sediment reaching a channel from hillslope erosion) under average weather conditions for the first year following simulated ground-based mechanical thinning/yarding, prescribed fire, and wildfire conditions in a relatively dry forested ecosystem in the inter-mountain west with precipitation mostly in the form of snow (Elliot and Robichaud, 2001). *Disturbed WEPP* is an

Internet-based computer program designed to predict runoff and rill/interrill erosion from undisturbed forests, forest fires (prescribed and wild), forests disturbed by timber harvesting, and rangelands under various cover conditions, and is based on Water Erosion Prediction Project (WEPP) model.

The greatest amount of erosion typically occurs in the first year following disturbance, and after several years, erosion declines to near zero. Thinning was assumed to reduce ground cover by 15 percent over a harvest unit, although this analysis did not include the road system used to accomplish thinning. This level of disturbance is, perhaps, conservatively high as evidence for total ground disturbance (i.e., disturbance as evidenced by compacted soil, rutted soil, and exposed soil) from landings, temporary roads, skid trails, and slash management was measured to be approximately 16 percent in a harvest unit thinned by ground-based mechanical harvesting on the Kaibab National Forest (MacDonald, 2013). The rate of sediment yield in the first year following simulated thinning and wildfire was predicted to be 0.03 Mg/hectare and 8.1 Mg/hectare, respectively. Predicted rates of sediment yield for simulated thinning followed by prescribed fire were approximately 0.1 Mg/hectare during the first year after disturbance.

These simulation results highlight the increase in erosion following wildfire versus that from vegetation treatment. When compared to natural rates of erosion in forest environments, which have been reported to be less than 0.1 Mg/hectare (Elliot, et.al., 1999), it can be seen that thinning or thinning combined with prescribed fire is not likely to substantially increase the amount of sediment reaching streamcoures, but that wildfire may do so by several orders of magnitude.

The BMPs that would be used to mitigate the effects of treatments are designed to:

- Minimize the amount of disturbance (e.g., requirement to designate skid trails and stream crossings, use of prescribed fire only when conditions are such that impacts to soils are minimized, etc.)
- Disconnect disturbed areas such as temporary roads, landings, and skid trails from streamcourses (e.g., designate aquatic management zones around streamcourses in which the amount of disturbance is minimized)
- Protect exposed soil through re-seeding and/or spread of slash
- Prevent the concentration of runoff on linear areas of disturbance (i.e., temporary roads, skid trails, and fire lines) through the use of such drainage features as rolling dips, water bars, and lead-out ditches.

Other methods that would be used to minimize disturbance include the use of up to 2.5 miles of existing road prisms as temporary roads, the rehabilitation of temporary roads after treatment by returning them to their pre-disturbance condition to the extent possible, and the decommissioning of up to 4.2 miles of existing roads currently designated as open to administrative use only. Because of the use of BMPs and these other methods of reducing disturbance, the amount of mobilized sediment reaching streamcourses would be minimized but not necessarily eliminated because of the nature of precipitation events in northern Arizona. In particular, the convective storms that occur during the summer months in northern Arizona may produce locally intense rainfall that drastically increases erosion in the absence of disturbance. Though rates of erosion in undisturbed forested areas of the western interior of North America are typically low, erosion rates may increase by several orders of magnitude as a function of the nature of precipitation (MacDonald and Stednick, 2003). This observation highlights the importance of the stochastic (or random) nature of erosion.

Cumulative Effects

Cumulative effects to water resources are the effects of activities described in the No Action Alternative cumulative effects section combined with direct/indirect effects to water resources from proposed vegetation treatments. Cumulative effects to springs, wetlands, and riparian areas from the action alternatives and effects from past, present, and reasonably foreseeable activities are not anticipated to impact these features because of 1) the use of BMPs, 2) the absence of riparian areas within the analysis area, and 3) because of the spatial separation between activities and springs and wetlands.

The effects of past, present, and reasonably foreseeable thinning activities associated with Jack Smith Schultz, Eastside, and 4FRII projects could potentially combine with thinning activities proposed under the action alternatives to increase water yield beyond that which would potentially occur from just the proposed thinning treatments. However, thinning treatments would all have to reduce forest cover by at least 15 percent, and the timing of treatments would have to be such that they occurred within the same catchments during the same 4 to 7 year period (Robichaud, et.al.2010).

Cumulative effects to water quality are not anticipated to be significant because of the dispersed nature, both in time and space, of ground-disturbing activities. Though there are likely to be short-term disturbances to forest soils with subsequent increases in sediment delivery to streamcourses, not all the cumulative increase in sediment delivery would occur during the same year and within the same streamcourse. The use of BMPs and proposed decommissioning of roads common to all past, present, proposed, and reasonably foreseeable future projects would limit disturbance to soils and the potential increase in sediment delivery to streamcourses. The combined effects of past, present, proposed, and reasonably foreseeable future vegetation treatment projects would be to reduce the potential for uncharacteristic wildfires in the affected environment catchments, thereby reducing potential threats to water quality in water bodies such as Upper Lake Mary.

Alternative 2: Proposed Action with Cable Logging

The effects to soils and water resources from prescribed fire, hand thinning with no removal, and ground-based mechanized thinning on slopes less than 40 percent as well as the cumulative effects of these activities were previously described in the section titled “Effects Common to all Action Alternatives” and so are not included in the discussion below.

Direct & Indirect Effects

The types of disturbance to soils from cable yarding are the same as those for ground-based mechanized harvesting but the magnitude of disturbance in terms of the area with visible soil disturbance, such as exposed soil and rutting, would be less than ground-based harvesting/skidding (Reeves, et.al. 2011).

In a study comparing the extent of soil disturbance associated with ground-based skidding, cable yarding, and helicopter yarding, Reeves, et.al. (2011) found that ground-based skidding produced the most soil disturbance (roughly 8.2 percent of harvested area excluding roads) with cable yarding next (roughly 3.8 percent of harvested area excluding roads) followed by helicopter yarding (roughly 0.2 percent of harvested area excluding roads).

Cable yarding typically results in some displacement of litter and exposure of soils particularly where one end of a harvested tree is in contact with the ground as it is transported upslope to a landing. However, the majority of ground cover within the cable corridors is left intact leaving the soils protected from erosion. Also, use of post thinning best management practices such as placement of slash over areas of exposed soil would further reduce erosion and increased runoff.

Although peer-reviewed studies of the impacts of cable logging on soils in the American southwest are lacking, there is at least some anecdotal evidence of the soil disturbance and associated erosion resulting from cable logging conducted in this region. In 2005, the Mescalero Apache Tribe began using cable yarding to extract logs up to 12 inches dbh from approximately 1,000 acres on hand-thinned slopes up to about 60 percent on the Mescalero Apache reservation near Ruidoso, New Mexico (Paul, 2014). Ruidoso, New Mexico receives roughly 60 percent of its annual precipitation during the period of June through September, the period encompassing the North American Monsoon, whereas Flagstaff receives roughly 40 percent of its annual precipitation during this same period. Cable yarding was conducted at all times of the year including the summer monsoon season. Although the cabling operation did expose bare mineral soil, which was expected, gouging of soil was infrequent and instances of increased runoff resulting in accelerated erosion and transport of sediment from the corridor did not occur even though thinning operations were conducted year-round with no post-treatment mitigation measures (Paul, 2014).

Alternative 3: Proposed Action without Cable Logging

The effects to soils and water resources from prescribed fire, hand thinning with no removal, and ground-based mechanized thinning on slopes less than 40 percent as well as the cumulative effects of these activities were previously described in the section titled "Effects Common to all Action Alternatives" and so are not included in the discussion below.

Direct & Indirect Effects

The treatments proposed in Alternative 3 are identical to those proposed in Alternative 2 except that helicopter yarding would replace cable yarding on approximately 973 acres and ground-based mechanized harvesting and skidding with specialized steep-slope equipment would occur on approximately 273 acres with slopes greater than 40 percent. Because helicopter yarding involves the transport of fully suspended logs to landings, there is no need for skid trails and cable corridors and less need for temporary roads. This means that the extent of soil disturbance under this alternative compared to alternative 2 would be less and potential impacts to water resources would be less.

The proposed thinning by mechanized harvesting and skidding on slopes greater than 40 percent would likely be done either with multi-wheeled harvesters or track mounted levelling feller-bunchers designed for operation on steep slopes. Skidding would be done by use of self-propelled forwarders requiring a separate entry for skidding or with harwarders (harvester and forwarder combined). In a study of the effects of harvesting on intermediate (10 to 25 percent) and steep slopes (26 to 43 percent), the overall amount of disturbance as a percentage of the harvested area was similar between slope classes, but the magnitude of disturbance expressed as amount of bare mineral soil exposed was greater in the steeper slope class (Cram, et.al., 2007). It was noted that disturbance was light to moderate, indicating less than nine percent exposure of bare mineral soil, when the harwarder traveled downslope but the amount of disturbance increased with uphill travel with areas of heavy disturbance (i.e., greater than 70 percent exposure of bare mineral soil) producing higher rates of runoff and erosion as determined through rainfall simulation experiments. There was no difference between rates of erosion in areas with no disturbance versus areas with light to moderate disturbance. This finding is consistent with research suggesting that erosion rates can be held to acceptably low rates when exposure of bare soil is less than 30 percent (MacDonald and Stednick, 2003). Disturbance associated with felling, delimbing, and bucking of logs was noted to be negligible.

Implementation of this alternative would require an amendment to the Forest Plan since ground-based thinning treatments on slopes exceeding a 40 percent gradient is currently prohibited. Through use of BMPs, it is anticipated that disturbance would be light to moderate on these slopes (i.e., no more than nine percent exposure of bare mineral soil), similar to the level of disturbance from ground-based thinning on slopes less than 40 percent. If more than nine percent exposure of bare mineral soil was noted on timber access routes, slash mats could be used to protect soils. Slash mats would be generated by delimbing felled trees such that the slash would be placed in the path of the harvester(s).

Alternative 4: Minimal Treatment

The effects to soils and water resources from prescribed fire, hand thinning with no removal, and ground-based mechanized thinning on slopes less than 40 percent as well as the cumulative effects of these activities were previously described in the section titled “Effects Common to all Action Alternatives” and so are not included in the discussion below.

Direct & Indirect Effects

There would be fewer disturbances to soils and, subsequently, less delivery of sediment to streamcourses from implementation of this alternative; however, it would not likely provide the same level of protection against the potential impacts to soils and water resources from an uncharacteristic wildfire since it would involve treating a smaller area.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

Implementation of a proposed amendment to the Forest Plan to allow mechanical treatments in MSO PACs beyond 9 inches dbh, treatments in MSO restricted habitat above 24 inches dbh, and treatments and prescribed burning within MSO nest/cores would result in improved vegetative ground cover over the long term by providing conditions conducive to the establishment of a more vigorous understory of grasses, forbs and shrubs. This increased vegetative ground cover would improve nutrient cycling and soil stability while reducing the risks to soils, water quality, and watershed function from the effects of a high severity fire. Proposed population and habitat monitoring would not pose a risk to soil, watershed function, and water quality.

Implementation of a proposed amendment to allow mechanical harvesting on slopes greater than 40 percent within the project area would facilitate thinning within the project area ultimately resulting in improved soil functioning and reducing the threat posed by a high severity fire to water quality, soil productivity and watershed function. Since the Forest Plan was written and amended, mechanized ground-based equipment has progressed to be able to operate on steep slopes more effectively.

Irreversible and Irretrievable Commitments of Resources

There would be no irreversible or irretrievable commitments of soil or water resources as a result of the proposed treatments or activities within the project area.

Wildlife

The following section summarizes existing conditions and effects from all alternatives to threatened, endangered, and Forest Service sensitive species (TES), management indicator species, migratory bird priority species that may occur or may have habitat within the FWPP. This section also discusses effects to wildlife cover and key habitat components such as snags and downed logs. Effects are summarized from the Wildlife Specialist Report, located in the project record.

Methodology

The Forest Service is legally required to comply with a number of federal regulatory requirements associated with various sections of the Endangered Species Act of 1973, as amended (ESA); the Bald and Golden Eagle Protection Act of 1940, as amended; Forest Service Manuals (FSM) 2620, 2630, 2670, and 2672; Migratory Bird Treaty Act of 1918 (as amended); Executive Order 13186 (migratory birds), National Environmental Policy Act, 1969; National Forest Management Act, 1976 (as amended); and the Coconino Forest Plan, as amended. The Wildlife Specialist Report contains more detailed information on the acts, manuals and Forest Plan guidance referenced above.

Specific methodology used for the analysis of impacts to wildlife are included in the species' discussions.

Threatened, Endangered and Forest Service Sensitive (TES) Species

The following TES species were analyzed because they are present or have habitat in the FWPP Action Area (Table 106). The Action Area is the project area and 0.5 mile buffer around the project.

Table 106: List of TES wildlife species that are present or have habitat in the FWPP action area

Common Name	Scientific Name	Status
Birds		
Mexican spotted owl	*Strix occidentalis lucida*	Threatened
Bald eagle	*Haliaeetus leucocephalus*	FS Sensitive
Northern goshawk	*Accipiter gentilis*	FS Sensitive
American peregrine falcon	*Falco peregrinus anatum*	FS Sensitive
Mammals		
Navajo Mogollon vole	*Microtus mogollonensis navajo*	FS Sensitive
Allen's lappet-browed bat	*Idionycteris phyllotis*	FS Sensitive
Pale Townsend's big-eared bat	*Corynorhinus townsendii pallescens*	FS Sensitive
Spotted bat	*Euderma maculatum*	FS Sensitive
Amphibians		
Northern leopard frog	*Rana pipiens*	FS Sensitive

Mexican Spotted Owl (Strix occidentalis lucida)

Analysis Methods

The following evaluation criteria were used to compare environmental consequences for alternatives:

- Change in Crown Fire Potential within MSO habitats
- Protected and Recovery Habitat Quality – Measures are primary constituent elements as identified for critical habitat which include; a range of tree species, canopy closure/cover, tree sizes suggestive of uneven-aged management and large dead trees (snags) with a diameter of 12 inches or greater.
- Prey Habitat – Measures are primary constituent elements as identified for critical habitat which include; volumes of fallen trees and other woody debris, plant species richness, including hardwoods, residual plant cover to maintain fruits, seeds, and regeneration to provide needs of MSO prey species.
- Noise disturbance associated with project implementation.

Figure 69: Picture of a Mexican spotted owl, courtesy of the Texas Fish and Game website (accessed February 19, 2014)

Affected Environment

On the Coconino National Forest, the MSO occupies mixed conifer and ponderosa pine/Gambel oak vegetation types, usually characterized by high canopy closure, high stem density, multi-layered canopies within the stand, numerous snags, and downed woody material.

MSO are nocturnal predators that feed primarily on small mammals. They are “perch and pounce” predators that locate prey from an elevated perch by sight or sound, then pounce on the prey and capture it with their talons. They consume a variety of prey throughout their range, but commonly eat small and medium-sized rodents such as woodrats, peromyscid mice, and microtine voles. They also eat bats, birds, reptiles, and arthropods.

The project area contains both MSO protected and recovery habitats. All of the suitable MSO habitat on the FWPP project has been surveyed. Surveys were done to USFWS protocols as described in the MSO Recovery Plan (USFWS 2012). Existing acres of MSO habitat are summarized in Table 107 and Table 110.

Protected Habitat (PACs)

There are ten Protected Activity Center (PACs) totaling 3,955 acres within the project area. Of that area, approximately 20 percent are nest/roost cores. PAC acres are summarized in Table 107 and displayed in Figure 70 (DLH) and Figure 71 (MM).

Table 107: Summary of acreages of MSO PACs and core areas in the project area

Habitat Type	Description	PAC* (acres)	Nest/Roost Core
Mormon Mountain	De Toro's	661	104 and 82
	Lockwood	149	0
	Moore Well	21	7
	Mormon Mountain	148	0
	Mormon Mountain North	610	109
	Weimer Springs	582	101
	Schultz Creek	659	122
Dry Lake Hills	Mount Elden	630	102
	Orion Spring	328	150
	Weatherford 2	163	8
	Total	**3955**	**785**

*PAC acres include nest/roost core

Additional PACs, not already listed above, that are within the Action Area defined in this report include: Archie's, Red Raspberry, Dairy Spring and Aspen Spring.

One of the primary concerns for MSO is the potential loss of habitat from uncharacteristic wildfire (USDI 2012). Crown fire potential was analyzed for both project areas using data generated from modeling performed using FlamMap 5.0. Three types of fires result from the modeling. Surface fire describes fire that burns through the surface fuels of the forest floor. This type of fire has the least active of fire behaviors and is the most beneficial of the three types of fires in maintaining the historical, ecological role of low intensity, high frequency fire in the southwestern ponderosa pine ecosystem. Passive crown fire, or torching, occurs when flame lengths are long enough to reach the lower edge of the canopy and can result in individual or small group tree torching but does not proliferate through the forest canopy through continuous crown fire spread. Active crown fire occurs when flames reach the forest canopy and spreads through it with intensity and continuity (Fire & Fuels Specialist Report). Table 108 and Table 109 summarize the Crown Fire Potential by fire type for MSO habitats with the project as modeled under Schultz Fire Weather Conditions (see Fire & Fuels section in this chapter for more information).

Table 108: Active crown fire potential in MSO habitats in Dry Lake Hills

Dry Lake Hills (Schultz Wildfire Weather Conditions)								
MSO	**PAC Name**	**Surface**	**%**	**Passive**	**%**	**Active**	**%**	**Total**
Recovery Mixed Conifer		622	35%	187	11%	962	54%	1771

Dry Lake Hills (Schultz Wildfire Weather Conditions)								
Recovery - Nest/Roost		55	51%	23	21%	30	28%	109
Recovery Pine Oak		107	39%	31	11%	135	49%	274
Protected PAC	Mt Elden	114	18%	62	10%	454	72%	630
Protected PAC	Orion Spring	150	46%	26	8%	150	46%	326
Protected PAC	Schultz Creek	118	18%	97	15%	443	67%	658
Protected PAC	Weatherford2	34	21%	20	13%	107	66%	162

Table 109: Active crown fire potential in MSO habitats for Mormon Mountain project area

Mormon Mountain (Schultz Wildfire Weather Conditions)								
MSO	**PAC Name**	**Surface**	**%**	**Passive**	**%**	**Active**	**%**	Total
Recovery Pine Oak		132	17%	14	2%	618	81%	764
Recovery Nest/Roost		1	5%	0	0%	21	95%	22
Protected PAC	Weimer Springs	196	34%	19	3%	367	63%	582
Protected PAC	Mormon Mountain North	147	24%	57	9%	406	67%	610
Protected PAC	Mormon Mountain	52	35%	2	1%	94	64%	148
Protected PAC	Moore Well Rock Dike	7	31%	2	7%	13	61%	21
Protected PAC	Lockwood	51	34%	1	1%	97	65%	149
Protected PAC	De Toros	133	20%	83	13%	445	67%	660

Approximately 65 percent of the protected habitat in the DLH area and 66 percent in the MM area was rated as having an Active Crown Fire, indicating that wildfire activity would result in more severe effects to ecosystem components than should occur for the natural fire regime.

Protected habitat is characterized by percent of basal area by size class and trees per acre greater than 18 inches diameter as well as the amount of course woody debris and snags greater than 18 inches dbh. As summarized in the Forest Structure and Health section, all of the protected habitat exceeds basal area minimums in large size classes with adequate number of large trees. On average, stands have less than half of their stand densities in young trees less than12 inches dbh. On average, approximately one-half to three-quarters of their stand densities are in the 12-18 inch dbh and greater than 18-inch dbh size classes. Course woody debris exceeds desired conditions in all protected habitat and snags greater than 18 inches dbh meet desired conditions in all areas except the pine/oak in the MM area.

Recovery Habitat
As shown in Table 110 and depicted in

Figure 70 (DLH) and

Figure 71 (MM), recovery habitat consists of 1,909 acres of mixed conifer and 1,066 acres of pine/oak. The project area does not contain any riparian habitats (Soil and Water Resource Specialist Report).

Table 110: Acreages of MSO Recovery Habitat within the Project Area

Habitat Type	Description	Acres of Recovery Habitat	Acres of Recovery Nest/Roost	Total Recovery Habitat
Mixed Conifer Recovery Habitat Outside of PACs	Dry Lake Hills	1800	109	1909
	Mormon Mountain	0	0	0
	Total	**1800**	**109**	**1909**
Pine-Oak Recovery Habitat Outside of PACs	Dry Lake Hills	277	0	277
	Mormon Mountain	767	22	789
	Total	**1044**	**22**	**1066**
Riparian Recovery Habitat Outside of PACs	Dry Lake Hills	0	0	0
	Mormon Mountain	0	0	0
	Total	**2844**	**131**	**2975**

Table 108 and Table 109 list the portion of recovery habitat with each fire type rating. Approximately 54 percent of the mixed conifer and 49 percent of the ponderosa pine recovery habitat in the DLH project area and 81 percent of the ponderosa pine recovery habitat in the MM project area was rated as having an Active Crown Fire, indicating that wildfire activity would result in more severe effects to ecosystem components than should occur under the natural fire regime.

Recovery habitat is characterized by basal area and percent of basal area of trees 12-18 inches dbh and trees per acre greater than 18 inches diameter as well as the amount of course woody debris and snags greater than 18 inches dbh. As discussed in the Silviculture section, all of the recovery habitat exceeds basal area minimums in large size classes with adequate number of large trees. On average, stands have less than half of their stand densities in young trees < 12 inches dbh. On average, approximately one-half to three-quarters of their stand densities are in the 12-18 inch size class. On average, course woody debris exceeds desired conditions in all recovery habitats and snags greater than 18 inches dbh meet desired conditions in all areas except the pine/oak in both project areas.

Forested areas in recovery habitats currently do not provide a sustainable level of owl nest/roost habitat distributed across the landscape. These conditions do not provide for replacement owl nest/roost habitat because current conditions inhibit recruitment of old-growth trees, thereby not favoring the creation of large snags in stands and accumulation of large down logs and woody debris on the forest floor over time. The dense overstory is preventing development of a structurally and biologically diverse assemblage of tree and understory species. Lack of stand diversity prohibits conditions that support a wide variety of prey species for MSO.

Recovery Nest/Roost Habitat

The 2012 MSO Recovery Plan calls for 25 percent of mixed conifer recovery habitat to consist of nest/roost habitat, having a minimum basal area of 120 ft^2 with at least 12 trees per acre greater than 18 inches dbh, and 10 percent of pine oak restricted habitat having a minimum basal area of 110 ft2 with at least 12 trees per acre[29] greater than 18 inches dbh. For the ponderosa pine,

[29] The 1987 Forest Plan identifies pine oak nest/roost habitat having a minimum basal area of 150 ft^2 with at least 20 trees per acre greater than 24 inches dbh.

nest/roost stands were identified in previous decisions or as part of the Four Forest Restoration Initiative (4FRI). For the mixed conifer, nest/roost stands have been identified through previous decisions and as part of a District-wide Assessment (USFS 2013). Approximately 131 acres of recovery nest/roost habitat occur within the project. Active Crown Fire Potential within recovery nest/roost habitat is 95 percent in DLH and 28 percent in MM (Table 108 and Table 109).

Designated Critical Habitat

Critical habitat is designated by the FWS to provide for the survival and recovery of listed species. For MSO, critical habitat includes areas within mapped boundaries of protected and recovery habitat and includes one or more of the primary constituent elements as listed in the Federal Register (USDI 2004). Critical habitat is in Upper Gila Mountains (UGM) Recovery Unit 14Critical habitat includes protected and recovery habitats within the USFWS-designated Critical habitat boundary.

Approximately 6,930 acres of critical habitat are within the project area and consists of 3,955 acres of protected habitat, 2,975 acres of recovery habitat and the remainder is other forest and woodland. Refer to the discussion under *Protected Activity Centers* for a description of conditions within protected habitat and refer to the discussion under *Recovery and Recovery Nest/Roost Habitat* for a description of conditions within recovery habitat. Table 111 summarizes critical habitat by habitat and project area.

Table 111: Critical Habitat within the FWPP Project Area

Habitat Type	Dry Lake Hills	Mormon Mountain	Project
Protected	1781	2174	3955
Recovery (Pine Oak)	277	789	1066
Recovery (Mixed Conifer)	1909	0	1909
Total	3967	2963	6930

Figure 70: Dry Lake Hills MSO Habitats

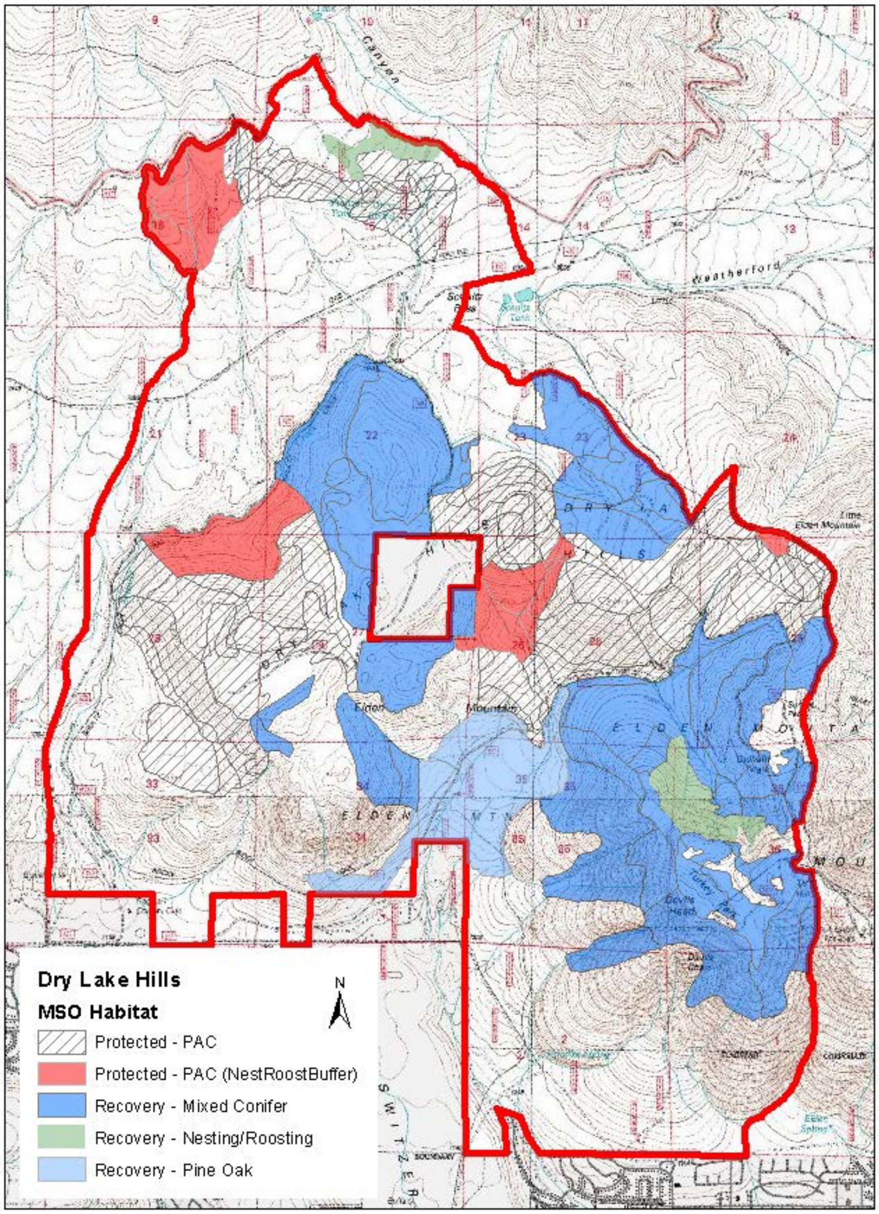
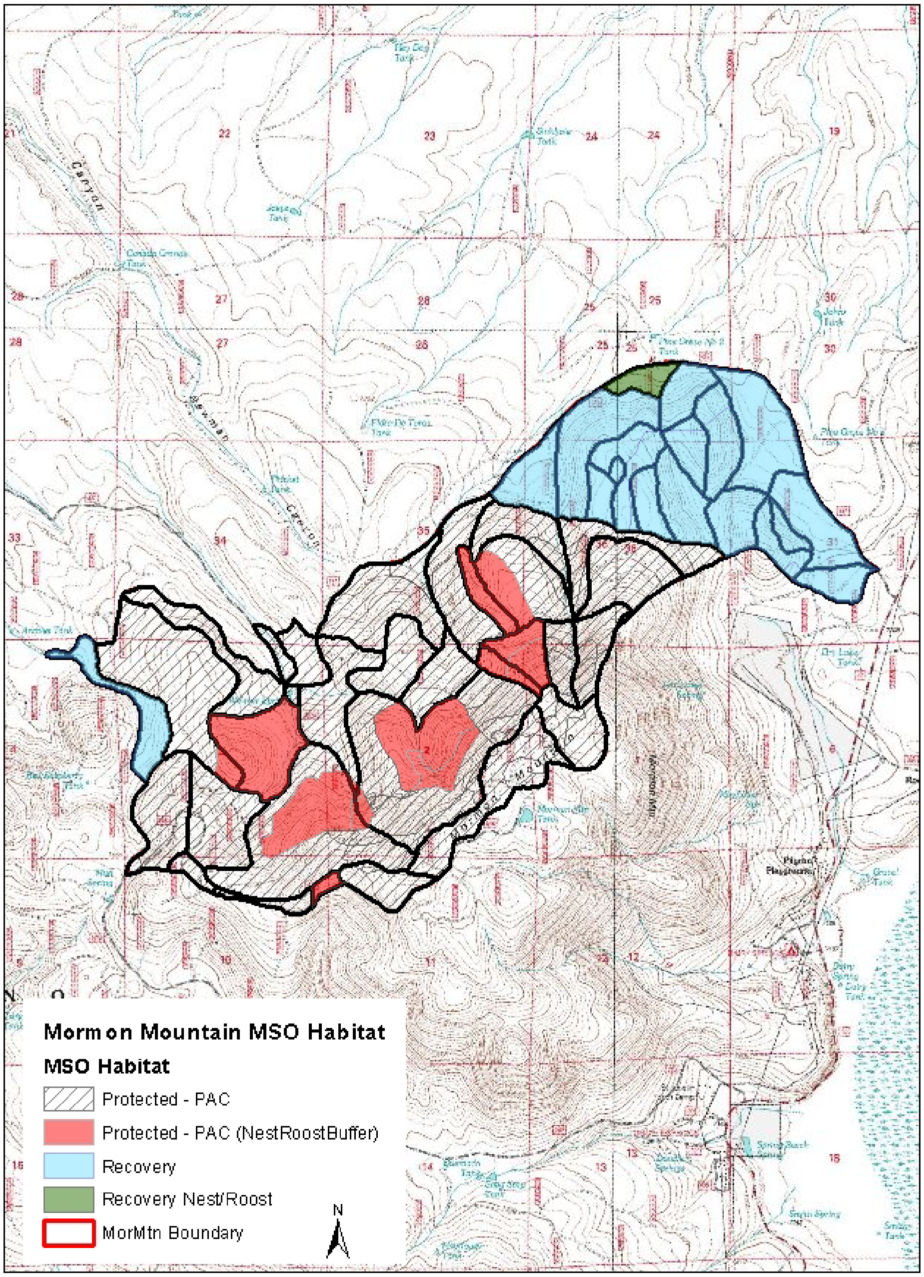


Figure 71: Mormon Mountain MSO Habitats



Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for MSO would remain in their current condition, notwithstanding natural processes such as insect outbreaks, lightning strikes etc. Under the No Action Alternative, there would be no direct effect on MSO; however there would be indirect effects. Dense forest conditions would exist and the crown fire potential would continue to place MSO habitat at risk with respect to stand-replacing fire. If a crown fire were to occur in MSO habitat, components for nesting, roosting and foraging would be reduced or eliminated, resulting in an indirect adverse effect. In addition, tree densities would continue to be high, slowing their growth into larger diameter classes and thereby limiting habitat for prey. Lastly, recent studies have shown a pervasive increase in tree mortality rates in old forests, which is interpreted as symptomatic of forests that are stressed and vulnerable to abrupt dieback (Ganey and Vojta 2011, Van Mantgem et al. 2009). Most recently this has been a result of bark beetle outbreaks and the combined effects of pests, disease, and drought that have resulted in nearly complete mortality of large trees in some cases (Van Mantgem et al. 2009). Without some type of management intervention, it is expected that forests will experience increasing stress, which would likely presage substantial changes in forest structure, composition, and function that would greatly impact MSO habitat needs (Notaro et al. 2012, Van Mantgem et al. 2009, Ganey and Vojta 2011).

If a ground fire occurred, it is likely that ladder fuels would carry fire into the dense canopies and turn into a passive or active crown fire. The No Action Alternative would not move to develop or maintain MSO habitat components.

Cumulative Effects

The cumulative effects boundary for MSO is the action area, defined as the project area and a one-half mile buffer around the project. Activity effects over one-half mile from the project boundary diminish to very low levels and would not impact owls within the project (i.e noise disturbance, smoke accumulations) and therefore would not combine with effects from this project. The time period analyzed for cumulative wildlife effects include a 20 year time period (2013 to 2033). The No Action Alternative would maintain or result in an increase in the current fire threat to MSO habitat and adjacent forest lands. The main effects to owls from this project are related to the adverse effect of noise disturbance from implementation and short term habitat effects and the long term beneficial effect of improved habitat conditions. All project implementation including maintenance burning is expected to be completed by 2033 and the desired forest structure in MSO habitat would develop within this period.

Under Alternative 1 there would be no affect from disturbance during implementation; however Alternative 1 would not prevent, delay, or ameliorate predicted effects of climate change, but would likely result in a continued trajectory toward increased stressors on the MSO. The dense forest conditions resulting from the no action alternative are at a high risk to density related and bark beetle mortality and have limited resilience to survive and recover from potential large scale impacts. Under warmer weather conditions and more frequent and severe droughts predicted for the Coconino National Forest (TACCIMO 2014), the potential impacts of these risks to the ecosystem would be increased. Individual tree growth would be limited to the point of stagnation. As tree density increases, many areas would experience higher mortality (Notaro et al. 2012, Van Mantgem et al. 2009, Ganey and Vojta 2011). Species, including the MSO, requiring closed canopy forest conditions or old or large tree, snag, and log structure would be negatively impacted in the long-term. This would combine with the loss of habitat from the adjacent Schultz Fire, the subsequent waterline project, and the Mormon Mountain powerline replacement project to further reduce MSO habitat quality.

The ability to retain sustainable and resilient ecosystems would be further compromised by vulnerability to high-severity fires. The overt threat of high-severity fire could limit options for treating uncharacteristic fuel loads through the use of unplanned ignitions, compounding the fire hazard through time.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Treatments were designed to move toward desired conditions as identified in the 2012 Mexican Spotted Owl Recovery Plan (MSO Recovery Plan) (USFWS 2012). Table 112 below lists the acres of treatments in MSO habitat.

Treatments follow the MSO Recovery Plan (USFWS 2012) in protected and recovery habitats with two exceptions: 1) trees greater than 24 inches dbh would be cut for cable corridors and 2) work would need to be completed in PACs during the breeding season to reduce the duration of disturbance from implementation.

Proposed Treatments in MSO Habitat
Table 112 lists the proposed treatments in MSO protected and restricted habitat under Alternative 2.

Table 112: Alternative 2 acres of thinning and/or burning proposed in MSO habitat

Treatment	Protected Habitat	Recovery Habitat
Mixed Conifer Fuels Reduction	0	1140
Mixed Conifer Fuels Reduction Burn Only	0	138
Mixed Conifer Fuels Reduction Hand Thinning	0	132
Ponderosa Pine Fuels Reduction Hand Thinning	0	14
Ponderosa Pine Fuels Reduction	0	1029
MSO PAC Fuels Reduction (wet mixed conifer)	180	0
MSO PAC Fuels Reduction	2759	0
MSO PAC Fuels Reduction- Hand Thinning	202	0
MSO Nest Fuels Reduction-Burn Only	663	0
MSO Nest Fuels Reduction- Hand Thinning	122	0
MSO Recovery Nest/Roost Hand Thin	0	94
MSO Recovery Nest/Roost Burn Only	0	37
Totals	3926	2584

Protected Habitat
Approximately 3,926 acres of protected habitat (PACs) (99 percent of protected habitat within the project) is proposed for thinning and/or burning treatments intended to abate fire hazard. Of that, approximately 122 acres are within the Schultz nest core, where trees would be thinned up to 5 inches dbh and dead and down material would be piled by hand and burned. Approximately 20 percent of the Schultz nest core would be deferred from treatment to maintain pockets of denser trees intended to provide more structural diversity for prey. Additionally, 663 acres are nest cores that would be a burn only treatment. No temporary roads would be constructed within nest cores; however there would be approximately 4.7 miles of temporary roads constructed within protected habitat and another 0.9 miles of road relocation (Table 116).

Recovery Habitat including Nest/Roost
Under Alternative 2, 2,315 acres (78 percent of the MSO recovery habitat, within the project) would be treated with mixed conifer or ponderosa pine fuels reduction treatments.

Approximately 131 acres of recovery habitat (4 percent of MSO recovery habitat, within the project area), including 94 acres of recovery nest/roost, would be hand thinned uneven-aged management with broadcast burning. An additional 138 acres of recovery and 37 acres of recovery nest/roost would be a burn only treatment.

Previous analysis has identified 131 acres as recovery nest/roost. These 131 acres of recovery habitat would be treated to develop into nest/roost habitat. No temporary roads would be constructed in recovery nest/roost habitat however; there would be approximately 7.0 miles of temporary road construction within recovery habitat and another 0.9 miles of road relocation in order to accomplish thinning treatments (Table 116). Temporary roads would be rehabilitated after harvesting has been completed.

Designated Critical Habitat

Under Alternative 2, 3,926 acres of protected habitat and 2,584 acres of recovery habitat would be treated within Critical Habitat as listed above.

Effects of Thinning and Prescribed Burning

Under Alternative 2, all treatments in MSO habitats would be designed to move toward the desired conditions as identified in the MSO Recovery Plan and described in the Wildlife Specialist Report (Appendix A, Table 1). Modeling shows that the treatments would move toward development of desired conditions both immediately after treatment and continuing over the next 20 to 40 years (Silviculturist Specialist Report). Treatments would be designed to maintain large snags, large logs and develop trees into the larger size classes. Snags would not be targeted for removal except where necessary for cable corridor locations and safety requirements in areas where trees would be felled by hand and removed by cable. Trees greater than 18 inches dbh would not be cut in protected habitat and trees greater than 24 inches dbh would not be cut in recovery habitat except where necessary for cable corridor locations (see next paragraph). Under Alternative 2, a Forest Plan amendment would allow for the removal of these trees in MSO habitat for cable corridors needed to facilitate skyline (a.k.a. cable) logging of steep slopes.

Skyline logging uses a system of cables to drag logs of whole trees from the cutting unit to a roadside landing. It is used on sites that are too steep for ground based operations. Roughly parallel “corridors” for the skyline needs to be placed every 100 to 140 feet. These corridors are approximately 12 feet wide and must have all trees removed from them to facilitate yarding. Much of this area contains large (greater than 24 inches dbh) pre-settlement trees and snags. Roughly 74 acres of protected habitat (approximately 2 percent of all protected habitat in the project area) and 91 acres of recovery habitat (approximately 3 percent of all recovery habitat in the project area) would be denuded by cable corridors (i.e. located within the corridors themselves). The Recovery Plan guidelines are to retain large trees (greater than 18 inches dbh) in protected habitat and retain trees greater than 24 inches dbh in recovery habitat. This alternative would remove roughly 132 trees greater than 18 inches dbh in 2 percent of the MSO protected habitat within the project area (24 MM and 108 DLH) and 74 trees greater than 24 inches dbh in approximately 3 percent of the recovery habitat within the project area. No cable corridors are proposed in MSO recovery habitat on MM; however cable corridors are proposed within MSO PACs on MM.

In addition, cable logging requires that all hazard trees be removed from the entire area that would be cable logged to provide for safety of personnel on the ground outside of protected (closed cab) machinery. A design feature requires biologists to identify patches of snags up to 10 acres in size to allow for retention of some snags in these areas. Not taking into account these patches, there would be approximately 391 acres in protected habitat (9 percent of all protected habitat within the project area) and 423 acres of recovery habitat (14 percent of all recovery habitat within the project area) where all snags could be removed to provide for safety. This loss of snags would reduce these key habitat components in protected and recovery habitats. This would likely move away from desired conditions for snags within the ponderosa pine in MM protected habitat and for ponderosa pine in both MM and DLH recovery habitat; however mixed conifer in both DLH and MM would continue to meet desired conditions.

This alternative would lead to a loss of more MSO key habitat components with a loss of more snags and trees greater than 18 inches dbh than any other action alternative. Table 113 summarizes the approximated loss of key habitat components within MSO habitats within areas cable logged, including cable corridors. Although there would be a loss of trees greater than 18 inches dbh in cable corridors within protected habitat and greater than 24 inches dbh in recovery habitat, when averaged across the cable treatment areas there would still be ample large trees to meet the desired conditions within MSO protected and recovery habitat after treatment habitat. Snags would move further away from desired conditions in ponderosa pine within the areas treated by cable logging. Design features such as retaining snag patches, and retaining large trees with dead tops, cavities and lightning strikes wherever possible would provide for replacement snags. Snags would be created if monitoring determines a deficit in these key areas and suitable replacement snags are not available.

Table 113: Alt. 2 Loss of MSO Key Habitat Components within Areas Cable Logged including Cable Corridors

Project Area	Recovery Habitat No. Trees >24” DBH Removed	Protected Habitat No. Trees >18” DBH Removed	Recovery Habitat No. Snags Removed	Protected Habitat No. Snags Removed
MM	0	24	12”-18” - 0	12”-18” -306
			>18” - 0	>18” - 34
DLH	206	108	12”-18” -1163	12”-18” -927
			>18” -857	>18” -707

Thinning and/or prescribed burning activities in MSO habitat may indirectly affect MSO by changing the owl’s habitat structure including snags, downed logs, woody debris, multi-storied canopies, and dense canopy cover. There is a potential for owls to relocate because of disturbance during treatment activities. The proposed thinning and burning may change the structure of MSO prey species’ habitat, affecting the abundance and composition of prey species. Although treatments, especially prescribed burning, may have varying effects to prey species in the short-term (generally one year, depending on climate and moisture) by impacting individuals of prey species due to disturbance of prey species’ habitat, the proposed treatments may increase the diversity of vegetative conditions, which in turn would provide for a diverse prey base. Empirical models of factors that influence availability of Mexican spotted owls five common prey species indicate that microhabitat manipulation can influence abundance of the Mexican vole, followed by the long-tailed vole, Mexican woodrat, deer mouse and lastly the brush mouse (Ward 2001). Ward (2001) found that the total available biomass (kg) of mice and voles provided the strongest correlation with reproductive output. Model results indicated that abundance (g/ha) of the two vole species could be influenced by manipulating grass-forb height, whereas abundance of Mexican woodrats, the preferred prey, might be influenced by promoting shrub diversity and increasing large log cover.

Table 114 and 115 below summarize the post-treatment Crown Fire Potential for DLH and MM. Crown Fire Potential after implementation of Alternative 2 would greatly reduce the potential for active crown fire in each of the four PACs in the DLH and all of the recovery habitat in this area and at the same time shift the majority of the habitat to crown fire potential of surface fire. The largest benefit in PACs would occur in the Schultz PAC where thinning is proposed within the nest core. For the MM project area crown fire potential after implementation of Alternative 2 would greatly reduce crown fire potential in each of the six PACs and all recovery habitat also shifting a majority of the acres to a surface fire rating.

Overall, this shift in fire type from active to surface will result in the majority of MSO habitat in the project area to be in a condition where low intensity, frequent fire would occur maintaining the historical, ecological role of fire.

Under Alternative 2, the percentage of protected and recovery habitat with active crown fire potential is reduced mitigating the potential for large, severe wildfires. The following tables reflect the change in crown fire potential within protected and recovery habitats.

Table 114: Alternatives 2 and 3 Post Treatment Crown Fire Potential

Dry Lake Hills (Schultz Wildfire Weather Conditions) ALT2 & 3								
MSO	**PAC Name**	**Surface**	**%**	**Passive**	**%**	**Active**	**%**	**Total**
Recovery - Mixed Conifer	n/a	1539	86%	39	2%	194	11%	1793
Recovery - Nesting/Roosting	n/a	109	100 %	0	0%	0	0%	109
Recovery - Pine Oak	n/a	275	99%	3	1%	0	0%	278
Protected - PAC	Mt Elden	450	72%	4	1%	174	28%	628
Protected - PAC	Orion Spring	311	95%	4	1%	12	4%	327
Protected - PAC	Schultz Creek	578	88%	1	0%	102	15%	660
Protected - PAC	Weatherford2	130	81%	8	5%	23	14%	161

Table 115: Alternatives 2 and 3 Post Treatment Crown Fire Potential

Mormon Mountain (Schultz Wildfire Weather Conditions) ALT2 & 3								
MSO	**PAC Name**	**Surface**	**%**	**Passive**	**%**	**Active**	**%**	Total
Recovery	n/a	623	82%	136	18%	1	0%	761
Recovery Nest/Roost	n/a	22	99%	0	1%	0	0%	22
Protected - PAC	Weimer Springs	559	96%	14	2%	7	1%	580

Mormon Mountain (Schultz Wildfire Weather Conditions) ALT2 & 3								
Protected - PAC	Mormon Mountain North	512	84%	93	15%	5	1%	610
Protected - PAC	Mormon Mountain	137	93%	10	7%	0	0%	147
Protected - PAC	Moore Well/Rock Dike	16	77%	5	23%	0	0%	21
Protected - PAC	Lockwood	150	100 %	0	0%	0	0%	150
Protected - PAC	De Toros	573	87%	69	11%	14	2%	657

By treating recovery habitat with a mixed conifer or ponderosa pine fuels reduction treatment and prescribed fire, wildfire-induced mortality of key habitat components in recovery habitat would be reduced for the next several decades. In thinned areas, there would be a short-term (1 to 2 years) increase in fire hazard in areas where slash needs to be cured before burning. However treatments would decrease fire hazard for several decades after thinning and burning treatments are complete.

Throughout the project, during broadcast burning activities, torching may occur within treatment areas. This torching is expected to create small openings of less than an acre in size; however a change in the stand structure from this type of event would not be detectable on a stand basis. Torching would mimic gap processes that occur under natural conditions (e.g. historic wildfire, windfall, and historic insect and disease outbreaks). Broadcast burning would decrease coarse woody debris in all protected and recovery habitat treatments; however, levels would range from 4 to 21 tons/acre and would exceed Forest Plan requirements. Woody debris and snags are habitat for small mammals. Indirect effects of reducing woody debris due to broadcast burning would decrease prey base abundance on a short-term basis for approximately one year (Jenness 2000). This decrease in small mammal prey base could be compounded during drought years when the prey base is lower due to a lack of food for these animals. However, herbaceous vegetation typically responds favorably to broadcast burning, and an increase in forage for small mammals is expected, outside of drought conditions. This in turn would have a corresponding increase in the small mammal prey base (Jenness 2000). Design features to protect snags and logs would reduce the number of snags and logs burned through a combination of burning techniques and lining (see Design Features). Recruitment snags would be identified from live trees that exhibit defects ideal for wildlife. For example, trees with spiked tops, lightning strikes, mistletoe brooms, or fading crowns.

Smoke from broadcast and pile-burning may temporarily disturb MSOs. Burning would be managed to minimize the accumulation of smoke in PACs during the breeding season (see Design Features). Short-term impacts from smoke would be reduced by coordination and timing and type of burning with wind direction, topography, time of year, and distance to PACs. Initial entry burning would not occur in nest cores during the breeding season and burning would be restricted during the breeding season in areas that may create smoke impacts to occupied PACs. Prevailing southwest winds and the topography of the area typically act to lift smoke, carrying it away from ignitions sites. PACs in DLH and MM are on raised topographic features and are not expected to have smoke settle in them long enough to cause discernable effects to MSOs because of air movement in these landscape-scaled features. With this information in mind, along with the concept that the species presumably adapted and evolved with smoke from wildland fire, smoke-related effects from maintenance burning would not be substantial.

Under Alternative 2, there would be indirect effects from the modification of vegetation. Burning, thinning and the associated ground disturbance could adversely affect the prey base on a short-term basis by impacting individuals of prey species due to disturbance of prey species' habitat and harm from fire. However, over the long- term, an increased diversity of vegetative structural stages and improved understory vegetation with improved plant species richness and would increase prey species, resulting in indirect beneficial impacts.

Effects of Ground Disturbance

Ground disturbance can cause indirect effects from the loss of vegetation through compaction and rutting and exposure of bare mineral soil. Landings, cable corridors, road construction and decommissioning, and other harvest activities could adversely affect the prey base on a short-term basis by impacting individuals of prey species due to disturbance of prey species' habitat. The following excerpt by the Kaibab National Forest's Soil Scientist estimates the percent of disturbance by harvesting type in Arizona ponderosa pine forest on slopes less than 40 percent:

"Mechanical thinning of the ponderosa pine forests of Arizona has been occurring since the 1980s mainly through whole tree harvesting on slopes less than 40%. Typical equipment used for such harvesting includes rubber-tired feller bunchers and rubber-tired skidders with tracked dozers used for piling of slash. The amount of disturbance as a percentage of a typical harvest unit (i.e., area included in a timber sale) impacted by compaction, rutting, and/or exposure of bare mineral soil from this type of harvesting has been estimated to be roughly 8% associated with feller-buncher and skidding operations, 3% associated with machine piling of slash, 3% associated with landings, and 3% associated with temporary roads (MacDonald, 2013)." This alternative's use of cable logging would mostly avoid ground disturbance from heavy machinery on steep slopes, and thus would generally prevent compaction, rutting, and/or exposer of bare mineral soil on slopes greater than 40 percent in the project area.

Of the 5,203 acres of ground based harvest method in MSO habitat, approximately 2,777 acres are protected habitat and 2,426 are recovery habitat. Roughly 728 acres (14 percent) could be impacted by compaction, rutting, and/or exposure of bare mineral soil. All harvest methods would require temporary roads (Table 116), which would result in additional acres that would be impacted by compaction and exposure of bare mineral soil. Temporary roads, including those along an existing road prism, road relocations and cable corridors needed for implementation have been identified and are summarized in Table 116.

Table 116: Alternative 2 - Miles/Acres of Cable Corridors, Temp and Relocated Roads in Protected and Recovery Habitat

	Acres treated by the Skyline/ Excaline Harvest Method*	Acres of Cable Corridors Skyline/ Excaline	Miles of Temp Roads/Road Relocation
DeToros PAC	39	5	.6/.1
Lockwood PAC	12	2	.2/0
Moore Well- Rock Dike PAC	0	0	0/0
Mormon Mountain PAC	0	2	.9/.4
Mormon Mountain North PAC	56	7	.8/.4

	Acres treated by the Skyline/ Excaline Harvest Method*	Acres of Cable Corridors Skyline/ Excaline	Miles of Temp Roads/Road Relocation
Weimer Springs PAC	0	0	0/0
Schultz Creek PAC	115	18	1.2/0
Mount Elden PAC	180	31	.9/0
Orion Spring PAC	49	7	.1/0
Weatherford2 PAC	14	2	0/0
Total Miles/Acres in PAC	**465 acres**	**74 acres**	**4.7/.9 miles**
Recovery Habitat	DLH- 514 MM - 0	DLH-91 MM-0	DLH-6.1 /.9 MM – .9/0
Recovery Nest/Roost	DLH – 0 MM - 0	DLH-0 MM-0	DLH- 0/0 MM – 0/0
Total Miles/Acres in Recovery	**514 acres**	**91 acres**	**7/.9 miles**
TOTAL	**979 acres**	**165 acres**	**11.7/1.8 miles**

*Acres treated by Skyline/Excaline harvest method include cable corridors

No temporary roads would be constructed in MSO nest cores, reducing the potential for adverse effects to nesting owls. Temporary roads, landings and skid trails would be needed in PACs and recovery habitats in order to accomplish thinning treatments; however all would be rehabilitated after harvesting. This alternative would have 4.7 miles of temporary roads in protected habitat and 7.0 miles in recovery habitat. The construction of temporary roads would remove important habitat components such as large trees, snags, and downed wood on approximately 8 acres (assuming a 14-foot wide road) in protect habitat and 15.3 acres in recovery habitat. Road relocations would be needed in order to accomplish thinning treatments with 0.9 mile in protected habitat and 0.9 mile in recovery habitat (affecting approximately 1.6 acres each).

Ground disturbance associated with landings, road decommissioning, temporary roads, cable corridors and ground based harvest activities would be short term and temporary in nature, and although roads, landings and corridors might displace prey they would not limit their numbers in MSO habitats. All ground disturbances would be rehabilitated after implementation. This alternative has the most temporary roads and road relocations in protected and recovery habitats of all the action alternatives.

Effects of Disturbance Associated with Project Implementation

Noise disturbance could be caused by project implementation activities including thinning and burning, road construction and maintenance, hauling of logs, and road rehabilitation in and adjacent to MSO habitat. In general, human activities have been documented to cause disturbance to raptors and in many instances can cause nest abandonment or changes in home range (Anderson et. al. 1990). Delaney and Grubb (2004) determined that spotted owls appear to be capable of hearing sounds from road maintenance equipment to distances of at least 400 meters (0.25 miles). No mechanical treatments would occur within nest cores. The potential for noise disturbance from hand thinning treatments to directly affect nesting owls would be reduced as no thinning would occur within the Schultz nest core during the breeding season if the nest is active. Treatments within individual PACs would be limited to no more than two breeding seasons (e.g. one entry), reducing the duration of potential disturbance to nesting owls.

Chainsaw operation caused most owls to flush from their perches when chainsaws were operated <60 meters (197 ft) from roosting Mexican spotted owls. Owl response decreased with increasing distance to noise source for chainsaw operation (Grubb 1999). Thinning and logging activities within the PAC but away from nesting locations are not expected to impact nesting success. Activities would occur during daylight hours when owls are typically roosting within the core area and would be protected from noise both by topographic and vegetative features. Owls are nocturnal and would forage within the PAC during nighttime hours when logging activities would not be occurring. Since disturbance from thinning activities is expected to be minimal during times when owls are active, the impacts from this activity are expected to be minimal. Noise associated with hauling could disturb nesting owls and may occur over for two to three years in MM and five to eight years in DLH. Activities associated with prescribed burning and thinning treatments conducted outside of the breeding season normally do not result in negative effects to the MSO. The MSO habitat within the project area has been surveyed according to approved protocols. Effects from proposed treatments to adult and young owls outside of PACs are unlikely.

Haul routes may cause noise disturbance to nesting owls and vehicles could potentially hit owls, causing injury or death. Most logging traffic would occur during day time hours when owls are not as mobile; however there could be occasions when trucks are operating at times when owls would be foraging in the area. Main haul routes have been identified and include Forest Roads (FR) 420, 556, and 557 for DLH and FR 132, 132A and 648 for MM. FR 420, 132, 132A and 648 pass within a quarter-mile of MSO nest or roost locations, increasing the potential for vehicle-related disturbance to nesting owls and collisions. Hauling of lumber within the DLH may occur within one-quarter mile of the Schultz Creek nest or roost locations during the breeding season. Hauling of logs from MM may occur within one-quarter mile of Weimer Spring, DeToros, Archies, Mormon Mountain and Moore-Well Rock Dike nest and roost locations during the breeding season. For Schultz, Archies, Mormon Mountain and Moore Well-Rock Dike, the haul routes skirt the quarter-mile buffer of known nests and roosts. But for Weimer Springs and DeToros, the 132A haul route cuts through the buffers, increasing the potential for disturbance. There would be an estimated 4,800 truckloads that could haul on these routes. This disturbance would occur consistently (i.e. greater than twice per hour) for an extended period of time (more than one hour) and could influence reproductive success if owls are nesting.

Alternative 2 would mechanically treat 4,697 acres in the DLH and 2,427 acres on MM, which roughly correlates to a maximum of 9,000 and 4,800 truckloads respectively of logs that would potentially be hauled adjacent to these nest cores. Based on a normal operating season of April 15 – November 30 (150-210 days) assuming mechanical treatments accomplish eight acres per day, skyline and excaline yarding accomplish two acres per day, it could potentially take from 5.4 to 7.5 years (breeding seasons) to complete implementation in the DLH and 1.6 to 2.3 years (breeding seasons) to complete implementation on MM. This is a conservative estimate; implementation could take less time to complete depending on weather, the contract procured, etc.

The MSO monitoring plan is designed to evaluate the effects of prescribed fire and hazardous fuels reduction treatments on spotted owl habitats, and to retain or move towards MSO desired conditions. This monitoring plan would provide valuable information on the effects of these activities on MSO and their habitat.

The Campfire Closure Order would establish a permanent campfire restriction order in the DLH portion of the project area. This would result in a reduction of campfires in and adjacent to MSO habitat limiting the potential for human-caused wildfire to impact these important habitats. This would also reduce wood harvesting associated with campfires reducing the removal of snags and logs, key habitat components for MSO and their prey.

Cumulative Effects

The cumulative effects boundary for MSO is the action area, defined as the project area and a one-half mile buffer around the project. Activity effects over one-half mile from the project boundary diminish to very low levels and would not impact owls within the project (i.e noise disturbance, smoke accumulations) and therefore would not combine with effects from FWPP. The time period analyzed for cumulative wildlife effects include a 20 year time period (2013 to 2033). The main effects to owls from this project are related to the adverse effect of noise disturbance from implementation and the beneficial effect of improved habitat conditions. All project implementation including maintenance burning is expected to be completed by 2033 and the desired forest structure in MSO habitat would develop within this period. Reviews of all projects (past, present and reasonably foreseeable) that have the potential to impact owls during implementation were analyzed (see Wildlife Specialist Report, Appendix D).

Review with the Forest Service Fuels Specialist concluded that smoke from broadcast and pile burning southwest of the project would have similar short-term (3-5 days) and low intensity (drift smoke) effects of smoke to individual MSO. Burning inside PACs occurs outside the breeding season for most projects. Burning outside of PACs during the breeding season is conducted in a manner that minimizes smoke impacts to MSO. However, it is anticipated that burning activities on portions of this project could occur simultaneously with burning activities on other fuels reduction projects. While there are numerous burning operations planned in areas adjacent to the project area, ADEQ standards limit the total amount of burning allowed in the airshed at a given time. Thus, smoke impacts to PACs are limited and expected to be the same as those analyzed in the direct and indirect effects section for this project.

Vegetation treatments proposed for the Four Forest Restoration Initiative (4FRI) will occur within the action area. Several PACs within the action area are proposed for burning. PACs within the action area proposed for vegetation treatment also include Red Raspberry and Archies. Restoration of springs are proposed within the Weimer Spring and Red Raspberry PACs. Recovery nest roost habitat was identified in ponderosa pine as part of the 4FRI analysis and nest roost recovery stands are located within FWPP. The FWPP incorporated these nest roost habitat delineations. Any impacts to MSO would be mitigated by coordinating with 4FRI to limit entries into PACs (see Design Features). Other ongoing implementation of fuels reduction projects such as Jack Smith Schultz, Eastside and Mormon Lake Basin are designed to minimize impacts to owls and mitigation of disturbance from implementation has been incorporated into the project design for all of these projects. Decreases would occur in coarse woody debris, logs, and snags in the ponderosa pine for all of the above fuels reduction projects and would combine with FWPP to move away from desired conditions in the ponderosa pine. Burn prescriptions and ignition techniques should limit overall losses of logs and snags. Burned snags would fall and provide logs and trees killed by fire would become snags. The longevity of fire-killed snags is less than that of snags formed from other processes. However, maintenance burning should provide pulses of snags and logs through time. Less course woody debris is expected to be present as a result of prescribed burning. Thinning and burning should increase tree growth rates and self-pruning of the lower tree branches through time should gradually replenish course woody debris. Improving growing conditions should decrease density-related mortality of larger and older trees. Improving recruitment into the larger size classes would improve MSO habitat and the ability to provide large snags that remain on the landscape longer than smaller diameter or fire-created snags.

Cumulative effects from other proposed projects such as Mount Elden Dry Lake Hills Trails Planning, which overlaps with this project, would combine with effects from ground disturbance and noise disturbance to MSO and their habitat in the action area. The development of trails within protected and recovery habitat reduces the quality of that habitat however, design features would be implemented to mitigate impacts. MEDL also proposes to reduce disturbance from one trail by relocating it outside of the Mt. Elden nest core. Implementation of trails, trailheads, etc. would be coordinated around FWPP implementation. Continued use of user-created trails in the DLH area may disturb roosting or nesting owls. New roads or trails would not be designated for public motorized or recreational use as part of the FWPP project, and all temporary roads would be obliterated after implementation.

There are additive effects of reduction of understory vegetation by livestock grazing in the Mormon Mountain project area. Livestock grazing would combine with short-term loss of understory vegetation from prescribed fire and logging operations. The Mormon Mountain project area is managed on deferred rotational and deferred rest rotation grazing systems designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. Prescribed burning would be coordinated with grazing schedules to minimize impacts to vegetation.

By managing for resistant and resilient ecosystems, promoting landscape connectivity, and implementing concepts of adaptive management, land and resource management can respond to new information and changing conditions related to climate change that have the potential to increase ecosystem risks. Risks associated with dense forest conditions would be reduced and forest resiliency large scale disturbance under drier and warmer conditions would be improved by implementing the treatments proposed under all action alternatives. Individual tree growth would improve, resulting in larger average tree sizes. Species requiring habitat elements associated with closed canopy forest conditions or old or large tree, snag, and log structure would be more sustainable as forest resiliency improved.

Determination of Effect

- Crown Fire Potential would be reduced in MSO habitats reducing the potential loss of habitat to wildfire.
- Trees would be thinned up to 5 inches dbh and dead and down material would be piled by hand and burned on approximately 122 acres within the Schultz nest core Approximately 20 percent of the nest core would be deferred from treatment to maintain pockets of denser trees intended to provide more structural diversity for prey.
- There would be no cable corridors or temporary roads constructed in nest cores or recovery nest/roost habitat.
- There would be the complete loss of trees (including snags and large trees) on 74 acres in protected and 91 acres in recovery habitat due to cable corridors. This correlates to roughly 232 live trees and 741 snags >18” dbh that would be cut. Large logs would be increased on these acres.
- With the exception of snag retention patches, there would be an additional loss of snags

on 391 acres in protected habitat and 423 acres in recovery habitat in areas cable logged. Large logs would be increased on these acres.

- Ground disturbance would impact 728 acres along with the construction of 11.7 miles of temporary roads and 1.8 miles road relocations in MSO habitat may have short term impacts to plant cover.
- There would be 3,926 acres of vegetation treatments in protected and 2,584 acres in recovery habitat that may have short term impacts but would have long term beneficial effects of improving habitat resilience and improving structure and function.
- There would be no thinning or burning or road construction/obliteration activities within nest cores during the breeding season. With the exception of hauling no PAC would be impacted by project activities for more than two years.
- Thinning activities would occur during the breeding season within some PACs being impacted for up to two years. Implementation would be designed to limit the number of breeding seasons that any one PAC would have thinning activities occurring during the breeding season. Monitoring would be used to inform treatment schedules.
- Hauling would occur within a quarter-mile of Schultz, Archies, Weimer Springs, DeToros, Mormon Mountain, and Moore Well-Rock Dike nest cores. There would be an estimated 4,800 truckloads that would haul on these routes.
- Burning activities would be coordinated with the district biologist and would be designed to limit smoke during the breeding season. Pile burning would be completed in the winter and initial entry prescribed burning would be completed in the fall/winter within PACs.
- The MSO monitoring plan is designed to evaluate the effects of prescribed fire and hazardous fuels reduction treatments on spotted owl habitats, and to retain or move towards MSO desired conditions. This monitoring plan would provide valuable information on the effects of these activities on MSO and their habitat.

Based on the above analysis it is my determination that the project's activities may adversely affect the Mexican spotted owl and its critical habitat.

Alternative 3: Proposed Action without Cable Logging

Refer to Table 112 for acres of thinning and burning proposed in MSO habitats. The acres of treatment are the same as Alternative 2, but with different harvest methods on steep slopes. Alternative 3 would use a combination of helicopter logging and specialized steep slope equipment to extract the timber rather than cable logging.

Direct & Indirect Effects

Effects from Thinning and Prescribed Burning

Under Alternative 3, treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. No cable logging would occur under this alternative, which would reduce the need to remove the large trees and logs on steep slopes and also the need to create corridors. Effects to MSO habitat are similar as those discussed under Alternative 2 as the treatments and desired conditions would be the same; however no trees greater than 18 inches dbh would be cut in PACs, and no trees greater than 24 inches dbh would be cut in recovery habitat due to the absence of cable logging corridors. Helicopter logging allows for more flexibility for snag patch locations and the distribution of snags and large trees would be more consistently random due to the absence of proposed cable corridors. The Forest Plan amendment required for this alternative would not require an amendment to the Forest Plan to remove trees greater than 24 inches dbh in MSO recovery habitat.

Helicopter logging requires that all hazard trees are removed from the entire area that is helicopter logged to provide for safety of personnel on the ground outside of protected (closed-cab) machinery. Where helicopter logging would occur, patch cuts may be used in order to break up fuels to allow for the maintenance of snags outside of patches while also allowing for greater removal of trees (live and dead) and operational safety within the patches. Biologists would identify patches of snags up to 10 acres in size in advance of treatment layout. Not taking into account these patches, there would be approximately 267 acres in protected habitat and 425 acres of recovery habitat where all snags could be removed to provide for safety. This loss of snags would reduce these key habitat components in protected and recovery habitats. No helicopter logging would occur in the MM area; those areas proposed for cable logging under Alternative 2 would be treated by steep slope equipment under Alternative 3. Under Alternative 3, there would be fewer large trees and snags cut within PACs and wet mixed conifer in the MM area than Alternative 2. Overall, this alternative would result in less impact to MSO key habitat components including snags, logs and large trees.

Post Treatment Crown Fire Potential is the same as Alternative 2. Table 108 and Table 109 summarize the post-treatment Crown Fire Potential for DLH and MM. Crown Fire Potential after implementation of Alternative 3 would greatly reduce the potential for active crown fire in each of the four PACs in the DLH and all of the recovery habitat in this area and at the same time shifting the majority of the habitat to crown fire potential of surface fire. The largest benefit in PACs would occur in the Schultz PAC where thinning is proposed within the nest core. For the Mormon Mountain project area crown fire potential after implementation of Alternative 3 would greatly reduce crown fire potential in each of the six PACs and all of the recovery habitat, also shifting a majority of the acres to a surface fire rating.

Overall, this shift in fire type from active crown fire to surface fire would result in the majority of MSO habitat in a condition where low intensity, frequent fire would occur maintaining the historical, ecological role of fire.

<u>Effects of Ground Disturbance</u>

Project activities that may cause ground disturbance include; logging and skidding operations, temporary and relocated roads, helicopter and log landings. Effects to MSO habitat are similar as Alternative 2; however some landings would be replaced by helilandings and no cable logging would occur under this alternative, which would reduce the need to create corridors. Table 117 summarizes the miles of temporary roads and road relocations in MSO habitats.

Table 117: Alternative 3 - Miles of Temp and Relocated Roads in Protected (by PAC) and Recovery Habitats

PAC	Miles of Temp Roads/Relocations
DeToros PAC	.4/.1
Lockwood PAC	.2/0
Moore Well PAC	0/0
Mormon Mountain PAC	.5/0
Mormon Mountain North PAC	.5/.4
Weimer Springs PAC	0/0
Schultz Creek PAC	1.2/0

PAC	Miles of Temp Roads/Relocations
Mount Elden PAC	.2/0
Orion Spring PAC	.1/0
Weatherford2 PAC	0/0
Total Miles in PACs	**3.1/.5**
Recovery Habitat	DLH – 3.5/.9 MM - .9/0
Recovery Nest/Roost	DLH – 0 MM - 0
Total Miles in Recovery	**4.4/0.9**
TOTAL	**7.5/1.4 miles**

No temporary roads would be constructed in MSO nest cores, reducing the potential for adverse effects to nesting owls. Temporary roads, landings and skid trails would be needed in PACs and recovery habitats in order to accomplish thinning treatments; however all would be rehabilitated after harvesting. This alternative would have 3.1 miles of temporary roads in protected habitat and 4.4 miles in recovery habitat. The construction of temporary roads would remove important habitat components such as large trees, snags, and downed wood on approximately 5.3 acres (assuming a 14-foot wide road) in protected habitat, and 7.5 acres in recovery habitat. Road reconstruction would be needed in order to accomplish thinning treatments with 0.5 mile in protected habitat and 0.9 mile in recovery habitat, affecting approximately 0.9 and 1.6 acres, respectively.

Although ground disturbance associated with landings and ground based harvest activities would be less than Alternative 2 due to the lack of corridors, it would be more than Alternative 4 because more acres within MSO habitats would be treated.

<u>Effects from Noise Disturbance from Project Implementation</u>
Disturbance would be similar to Alternative 2; however there would be additional disturbance from helicopter operations. Prior to implementation, an implementation guide would be developed to insure helicopter landings and flight patterns are located in areas away from nesting owls.

The use of helicopter logging would require landings where trees are processed at the landing area with a processor. Delaney (1999) indicates 105-m (344 ft) buffer zone for helicopter overflights would minimize impacts of helicopter overflights on MSO. PACs in the MM area would not be impacted as no helicopter logging would occur in that project area; however, all PACs in the DLH area could be impacted. Implementation of all proposed helicopter logging treatments within MSO habitats (protected and recovery) in the DLH would likely exceed 140 days in duration. However, a design feature to limit thinning and logging in each PAC to no more than two breeding seasons would limit the duration any one PAC would be impacted. An implementation plan would be designed to ensure helicopter operations (i.e. helilanding locations, flight patterns) would minimize impacts to nesting owls (see Design Features).

Cumulative Effects

Cumulative effects are the same in nature as that of Alternative 2, but would be slightly less since no trees greater than 18 inches dbh would be cut in PACs, and no trees greater than 24 inches dbh would be cut in recovery habitat. This is not expected to change the cumulative effects from that analyzed for Alternative 2 because even given the limited removal of large trees in Alternative 2, there would still be ample large trees to meet desired conditions when averaged across the project area.

Determination of Effect

- Crown Fire Potential would be reduced in MSO habitats reducing the potential loss of habitat to wildfire.
- Trees would be thinned up to 5 inches dbh and dead and down material would be piled by hand and burned on approximately 122 acres within the Schultz nest core Approximately 20 percent of the nest core would be deferred from treatment to maintain pockets of denser trees intended to provide more structural diversity for prey.
- There would be no helicopter logging or temporary roads construction in nest cores or recovery nest/roost habitat.
- With the exception of hauling there would be no thinning, burning or road construction/obliteration in nest cores during the breeding season.
- With the exception of snag retention patches, there would be a loss of snags on 267 acres in protected and 425 acres recovery habitat in areas where helicopter logging is the harvest method.
- Ground disturbance would impact 728 acres along with the construction of 7.5 miles of temporary roads and 1.4 miles road reconstruction in MSO habitat may have short term impacts to plant cover.
- There would be 3,954 acres of vegetation treatments in protected and 2,584 acres in recovery habitat that may have short term impacts but would have long term benefits by improving habitat resilience and improving structure and function.
- Thinning activities would occur during the breeding season in the project area. Implementation would be designed to limit the number of breeding seasons so that any individual PAC would not have thinning activities occurring during the breeding season for more than two breeding season. Monitoring would be used to inform treatment schedules.
- Hauling would occur within a quarter-mile of Schultz, Archies, Weimer Springs, Detoros, Mormon Mountain, and Moore Well-Rock Dike nest cores. There would be an estimated 4,700 truckloads that would haul on these routes.
- Burning activities would be coordinated with the district biologist and would be designed to limit smoke during the breeding season. Pile burning would be completed in the winter and initial prescribed burning would be completed in the fall/winter within PACs.
- Other activities, such as thinning, burning and temporary roads may have short term impacts but would have long term benefits by improving habitat resilience and structure and function.
- The MSO monitoring plan is designed to evaluate the effects of prescribed fire and hazardous fuels reduction treatments on spotted owl habitats, and to measure retention or movement towards MSO desired conditions. This monitoring plan would provide valuable information on the effects of these activities on MSO and their habitat.

Based on the above analysis it is my determination that the project's activities may adversely affect the Mexican spotted owl and its critical habitat.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Alternative 4 proposes the minimal amount of treatment necessary to meet the purpose and need. Treatments are proposed for those areas with dense fuel loading where topography aligns with dominant winds and the probability of severe effects to soil resources from a wildfire is greater, based on FLAMMAP modeling. Table 118 summarizes the acres of treatments proposed in MSO habitats.

Table 118: Alternative 4 - Acres of Treatments in MSO Habitat

Treatment Name	Protected Habitat	Recovery Habitat
Mixed Conifer Fuels Reduction	0	542
Ponderosa Pine Fuels Reduction – Hand thinning	0	86
Ponderosa Pine Fuels Reduction	0	277
MSO PAC Fuels Reduction (wet mixed conifer)	0	0
MSO PAC Fuels Reduction	2077	0
MSO PAC Fuels Reduction- Hand Thinning	228	0
MSO Nest Fuels Reduction – Burn Only	0	0
MSO Nest Fuels Reduction – Hand Thinning	122	0
MSO Recovery Nest/Roost	0	22
Totals	2427	927

<u>Effects from Thinning and Prescribed Burning</u>
This alternative would have the least amount of thinning and prescribed burning in MSO habitats of all the alternatives. For the MM area, not treating the wet mixed conifer would result in less opportunity for creating openings within aspen stands to promote aspen regeneration within protected habitat in the MM area. Heavy fuel loading would continue to be present in many portions of the project area as dead and down material would remain on site, thereby increasing the chance for more severe wildlife effects if one were to occur. This would also not encourage stand heterogeneity in many areas within the project boundary, resulting in less diversity of prey habitat.

The Spruce Avenue Wash was identified as a high priority area due to the fuel loading, topography, size and also its location relative to the City of Flagstaff and MSO PACs. The portion of the Elden MSO PAC within the Spruce Avenue Wash would also be treated under the same parameters described in Alternatives 2 and 3.The Schultz MSO PAC and nest core were identified in conjunction with the FWS as high priority areas, and would also receive the same treatment described for Alternatives 2 and 3. No treatment in other nest cores would occur under this alternative. Treatments in both the Schultz and Elden PACs and the Schultz nest core would reduce the crown fire potential in those PACs (Table 119and Table 120).

There would be no cable corridors or areas harvested by cable or helicopter logging within protected or recovery habitat, and temporary roads would be reduced slightly within these habitats (3.1 miles in protected habitat and 4.4 miles in restricted; see Table 121). This alternative would not require the Forest Plan amendment to include cutting trees greater than 24 inches dbh in recovery habitat. This alternative would have fewer snags and large trees removed from MSO habitats than Alternative 2 and 3, but would have more removed than Alternative 1.

Table 119 and Table 120 below summarize the post-treatment Crown Fire Potential for DLH and MM. Under Alternative 4, Crown Fire Potential 20 years after implementation would be greatly reduced in three of the four PACs in the DLH and in the recovery habitat, at the same time shifting the majority of the habitat to surface fire. The largest benefit in PACs would occur in the Schultz PAC where thinning is proposed within 80 percent of the nest core. Acres of treatment are less than the other action alternatives; Alternative 4 shows fewer acres shifting from crown to surface fire in the four DLH PACs. Crown fire potential increases in the recovery nest/roost habitat and in the Orion Springs PAC. This means that even though these stands are receiving treatment, it is not intense enough to show a large decrease in crown fire potential (Wes Hall, personal communication, 1/21/2014). For the MM area, crown fire potential after implementation of Alternative 4 would greatly reduce active crown fire potential in each of the six PACs and all of the recovery habitat would also shift a majority of the acres to a surface fire rating.

Overall, this shift in fire type from active to surface would result in the majority of MSO habitat in a condition where low intensity, frequent fire would occur maintaining the historical, ecological role of fire.

Table 119: Alternative 4 Post Treatment Crown Fire Potential in MSO Habitats, DLH

Dry Lake Hills (Schultz Wildfire Weather Conditions)								
MSO	PAC Name	Surface	%	Passive	%	Active	%	Total
Recovery Mixed Conifer		824	46%	195	11%	740	41%	1794
Recovery - Nesting/Roosting		32	29%	15	14%	59	55%	109
Recovery Pine Oak		202	73%	8	3%	67	24%	278
Protected PAC	Mt Elden	248	40%	26	4%	353	56%	628
Protected PAC	Orion Spring	105	32%	9	3%	214	65%	329

Dry Lake Hills (Schultz Wildfire Weather Conditions)								
Protected PAC	Schultz Creek	650	99%	1	0%	8	1%	660
Protected PAC	Weatherford2	70	43%	0	0%	88	55%	161

Table 120: Alternative 4 Post Treatment Crown Fire Potential in MSO habitats, MM

Mormon Mountain (Schultz Wildfire Weather Conditions)								
MSO	**PAC Name**	**Surface**	**%**	**Passive**	**%**	**Active**	**%**	Total
Recovery		758	99%	0	0%	4	0%	764
Recovery Nest/Roost		21	100%	0	0%	0	0%	22
Protected PAC	Weimer Springs	496		24	4%	63	11%	582
Protected PAC	Mormon Mountain North	452	85%	55	9%	105	17%	610
Protected PAC	Mormon Mountain	63	74%	43	29%	42	28%	148
Protected PAC	Moore Well Rock Dike	14	42%	2	11%	6	26%	21
Protected PAC	Lockwood	139	63%	2	1%	9	6%	149
Protected PAC	De Toros	216	33%	113	17%	328	50%	660

With fewer acres of treatment, thinning treatments could potentially be accomplished in a shorter time frame, reducing the duration of noise disturbance during the MSO nesting season.

<u>Ground Disturbance</u>

Ground disturbance would be primarily from operation of equipment, landings and temporary roads. Of the 2,918 acres of ground based harvest method in MSO habitat, approximately 2,077 acres are protected habitat and 841 acres are recovery habitat. Roughly 408 acres (14 percent) could be impacted by compaction, rutting, and/or exposure of bare mineral soil. Table 121 summarizes the acres of temporary roads required within MSO habitats for Alternative 4.

Table 121: Alt 4 - Number/Acres of Temp and Relocated Roads in Protected (by PAC) and Recovery Habitat

	PAC Name	Miles of Temp Roads/ Relocated Roads
Protected	DeToros	.5/.1
	Lockwood	.2/0
	Moore Well –Rock Dike	0/0

Protected	PAC Name	Miles of Temp Roads/ Relocated Roads
	Mormon Mountain	.5/0
	Mormon Mountain North	.5/.4
	Weimer Springs	0/0
	Schultz Creek	1.2/.1
	Mount Elden	.2/0
	Orion Spring	0/0
	Weatherford2	0/0
Total Protected		3.1/.6
Recovery	Recovery Habitat Type	
	Recovery Habitat	DLH - 3.5/.9 MM - .9/0
	Recovery Nest/Roost	DLH - 0/0 MM – 0/0
	Total	4.4/0.9

No temporary roads would be constructed in MSO nest cores, reducing the potential for adverse effects to nesting owls. Temporary roads, landings and skid trails would be needed in PACs and recovery habitats in order to accomplish thinning treatments; however all would be rehabilitated after harvesting. This alternative would have 3.1 miles of temporary roads in protected habitat and 4.4 miles in recovery habitat. The construction of temporary roads would remove important habitat components such as large trees, snags, and downed wood on approximately 5.3 acres (assuming a 14-foot wide road) in protected habitat, and 7.5 acres in recovery habitat. Road relocations would be needed in order to accomplish thinning treatments with 0.6 mile in protected habitat and 0.9 mile in recovery habitat, affecting approximately 1.0 and 1.6 acres, respectively.

<u>Effects from Disturbance from Project Implementation</u>

This alternative would have the least amount of total disturbance from project implementation. There would be no disturbance from helicopter operations or cable logging corridors. Although the same haul routes would be used, there would not be as many vehicle trips required and the duration of the project would be shorter than the other action alternatives: approximately 6,800 total vehicle trips in the DLH and 4,700 in MM compared to 9,000 in DLH and 4,800 and 4,700 in MM for Alternatives 2 and 3, respectively.

Cumulative Effects

Cumulative effects are similar to Alternatives 2 and 3, but would be slightly less since no trees greater than 18 inches dbh would be cut in PACs, and no trees greater than 24 inches dbh would be cut in recovery habitat. This is not expected to change the cumulative effects conclusions from that analyzed for Alternative 2 because even given the removal of large trees in Alternative 2, there would still be ample large trees to meet desired conditions when averaged across the project area.

This alternative would remove many fewer snags compared to Alternatives 2 and 3 and thus would not have similar cumulative effects from snag removal. This alternative would include removal of snags on up to 16 acres where there is temporary road construction or road reconstruction. This could combine cumulatively with impacts to snags from adjacent treatments that result from the 4FRI project, which is also likely to remove a small number of snags for temporary road construction. This cumulative effect is of most importance in the MM treatment area where there is more overlap with 4FRI treatments and snag numbers are currently not meeting desired conditions in protected or recovery habitat.

Determination of Effect

- Crown Fire Potential would be reduced in MSO habitats reducing the potential loss of habitat to wildfire.
- Trees would be thinned up to 5 inches dbh and dead and down material would be piled by hand and burned on approximately 122 acres within the Schultz nest core Approximately 20 percent of the nest core would be deferred from treatment to maintain pockets of denser trees intended to provide more structural diversity for prey.
- There would be no cable corridors, helicopter logging operations, or temporary roads construction in nest cores or recovery nest/roost habitat.
- There would be no thinning, burning road construction or obliteration activities within nest cores during the breeding season, and with the exception of hauling, no individual PAC would be impacted for more than two years.
- Hauling would occur within a quarter-mile of Schultz, Archies, Weimer Springs, DeToros, Mormon Mountain, and Moore Well-Rock Dike nest cores. There would be an approximate 4,700 truckloads that would haul on these routes.
- There would be no significant loss of snags, large trees or other key habitat components in MSO habitats.
- Ground disturbance would impact 408 acres along with the construction of 7.5 miles of temporary roads and 1.5 miles of road relocations in MSO habitat may have short term impacts to plant cover.
- There would be 2,427 acres of vegetation treatments in protected and 927 acres in recovery habitat that may have short term impacts but would have long term benefits by improving habitat resilience and improving structure and function.
- Burning activities would be coordinated with the district biologist and would be designed to limit smoke during the breeding season. Pile burning would be completed in the winter and prescribed burning would be completed in the fall/winter within PACs.
- Other activities, such as thinning, burning and temporary roads may have short term impacts but would have long term benefits by improving habitat resilience and structure and function.
- The MSO monitoring plan is designed to evaluate the effects of prescribed fire and hazardous fuels reduction treatments on spotted owl habitats, and to retain or move towards MSO desired conditions. This monitoring plan would provide valuable information on the effects of these activities on MSO and their habitat.

Based on the above analysis it is my determination that the project’s activities may adversely affect the Mexican spotted owl and its habitat. The project activities may affect, but are not likely to adversely affect MSO critical habitat.

Bald Eagle

Analysis Methods

The following evaluation criteria were used to compare environmental consequences for alternatives:

- Removal of potential habitat
- Disturbance from project implementation

Affected Environment

The bald eagle was removed from the list of threatened and endangered species August 8, 2007 (USDI 2007). Eagles are currently protected under the Golden and Bald Eagle Protection Act and bald eagles are a Forest Service Sensitive species.

The DLH area does not have occupied or potential nesting or roosting habitat. Though the MM area does not contain any known bald eagle nests or winter roosts, it is within one mile of Mormon Lake and as such provides potential nesting and roosting habitat. The nearest documented winter roost is located approximately two miles southeast of the project boundary at Mormon Lake. Groups of old growth ponderosa pine that are dominated by large, tall trees with open canopies occur throughout the MM area. Roosts on the Coconino National Forest are often associated with water bodies large enough to support reliable populations of fish and waterfowl (Dargan 1991). Although the project area does not contain any such water bodies, bald eagles may still establish roosts in the area, given the presence of suitable tree stands and the proximity of Mormon Lake as a reliable prey source. Recruitment of future suitable winter roost habitat has been reduced by wildfire suppression, facilitating the expansion of dense stands of small trees and preventing the development of large diameter trees and snags.

As mentioned above, there are no known nesting bald eagles within the project area. The closest known breeding bald eagles use three nests along Lower Lake Mary that are located approximately 4, 5 and 7 miles north of the MM area, respectively. In Arizona, bald eagles typically nest within one mile of a major river or water body, and most breeding areas contain riparian vegetation (Driscoll et al. 2006). These components are not present within one mile of the DLH and it is unlikely that that project area would provide nest sites for bald eagles in the future.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions would remain in their current condition, notwithstanding natural processes. Because there would be no habitat altering activities or disturbance associated with project implementation, this alternative would have no direct effect on the bald eagle. However, dense forest conditions would still occur and the high fire hazard potential would continue to place potential bald eagle roosting and foraging habitat at risk with respect to stand-replacing fire, resulting in indirect adverse effects.

Tree densities would continue to be high, slowing their growth into larger diameter classes and thereby limiting the development of larger diameter (greater than 18 inch dbh) trees important for roosting and perching. This would have an indirect adverse effect on bald eagle habitat.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to bald eagle habitat and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place bald eagle habitat and adjacent habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. Forests would continue to be susceptible to the effects of climate change including vulnerability to insects, disease, and high severity fire, thus continuing to have a negative effect to potential bald eagle habitat.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Direct effects would be from activities that cause disturbances (smoke, auditory or visual) to bald eagles within or adjacent to the project. Under Alternative 2, there would be no direct effects to nesting or roosting eagles as the nearest breeding area is four miles from the project and the nearest roost is two miles away, and noise generated from these activities is not expected to be audible at the nearest nest or roost sites. Smoke from burning in the Mormon Mountain project area is expected to settle within the low lying areas of the Lake Mary Watershed and could adversely affect nesting eagles. Spring or summer burning in the Mormon Mountain project area would be coordinated with the District Biologist and FWS personnel if any of the three eagle nests are occupied. Typically nesting can be confirmed by May.

Skyline logging uses a system of cables to drag logs of whole trees from the cutting unit to a roadside landing. It is used on sites that are too steep for ground based operations. Roughly parallel “corridors” for the skyline needs to be placed every 100 to 140 feet. These corridors are approximately 12-feet wide and must have all trees removed from them to facilitate yarding. Much of this area contains large (greater than 24 inches dbh) pre-settlement trees and snags. Roughly 45 acres of potential nesting/roosting would be denuded by cable corridors (Wildlife Specialist Report, Appendix C). This loss of large trees would be compensated as treatments are designed to grow trees into the larger size classes over time.

In addition, cable logging requires that all hazard trees are removed from the entire area that is cable logged to provide for safety of personnel on the ground outside of protected machinery. A design feature requires biologists to identify patches of snags up to 10 acres in size to allow for retention of some snags in these areas. Not taking into account these patches, there would be approximately 61 acres in potential bald eagle nesting/roosting habitat where all snags could be removed to provide for safety (Wildlife Specialist Report, Appendix C).

Under Alternative 2, mechanical treatments, broadcast and pile burning and hauling of timber may cause visual or auditory disturbance to foraging bald eagles. This disturbance would be localized, of short duration and low intensity and may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Indirect effects to the bald eagle include effects to eagle habitat, eagle prey species, or prey species habitat. There are no anticipated adverse effects to prey species or prey species habitat. Indirect effects to habitat would occur from treatments that modify the number of trees in a group of suitable roost trees, as eagles prefer to roost in large trees within close proximity to other large trees. However, thinning would improve old tree longevity, resulting in beneficial effects. Design features to protect snags would reduce the number of snags and logs burned through a combination of burning techniques and lining (see Design Features). Recruitment snags would be identified from live trees that exhibit defects ideal for wildlife. For example, trees with spiked tops, lightning strikes, mistletoe brooms, or fading crowns.

In addition, Alternative 2 would include developing old-growth stands in 74 percent of the MM area that may be used as future winter roost sites for bald eagles.

Cumulative Effects

The cumulative effects boundary is the action area, defined as the project area and a one-half mile buffer. Effects for a period of 20 years beginning with implementation of the project were considered. There is no effect to nesting eagles as there are no nesting eagles present within the project area; however, there may be possible short-term disturbance to potential roosting habitat with long term benefits. Short term disturbance to foraging bald eagles would occur during thinning and broadcast burning activities and may cause eagles to forage in nearby areas for the duration of the activity. These short-term impacts added to similar impacts from past, present, and reasonable foreseeable projects (including 4FRI and Mormon Lake Basin Fuels Reduction Projects) were considered. Implementation of other fuels reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Vegetation treatments in adjacent projects would also improve tree vigor and growth, and vegetative structural stage diversity, thus promoting the growth of larger trees and habitat components for eagles as well as the forest's resiliency to climate change. Other cumulative effects include hazard tree removal for powerlines, communication sites and highways, which have reduced the number of snags and large trees for perching along potential winter foraging areas in the project area; however it is not anticipated to combine to cause a negative effect.

Determination of Effect

The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Effects to bald eagle habitat are similar as Alternative 2 in that the treatments and desired conditions would be the same; however the distribution of snags and large trees would be more consistently random due to the absence of proposed cable corridors and areas where snags would be removed for safety purposes. Treatments would utilize ground-based harvesting across the majority of the project area, and helicopter would not be used in the MM area where bald eagles are known to occur. This would reduce the number of large trees and snags cut within potential bald eagle nesting/roosting habitat in the MM area.

Since no helicopters would be used to harvest trees in the MM area, there would be no potential for noise disturbance from helicopters to bald eagles. Fuels reduction treatments may cause visual or auditory disturbance to foraging eagles.

Cumulative Effects

Cumulative effects are the same as Alternative 2.

Determination of Effect

The project's activities may impact individuals but are not likely to cause a trend toward listing or loss of viability.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Effects to bald eagle habitat are similar to Alternative 3 as there would be no cable corridors or areas harvested by cable or helicopter logging required to accomplish thinning treatments reducing the need to remove potential perch or roost trees.

There would be 630 fewer acres of thinning and burning treatments in MM, where bald eagle habitat occurs, reducing the development of larger size classes to only those areas to be treated.

Cumulative Effects

Cumulative effects are the same as the other action alternatives, but to a slightly lesser extent as fewer acres would be treated.

Determination of Effect

The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Northern Goshawk

Analysis Methods

The following evaluation criteria were used to compare environmental consequences for all alternatives:

- VSS distribution and canopy cover within post-fledging family area (PFA) and areas outside PFAs
- Canopy cover within post-fledging family area, nest stands and foraging area
- Disturbance from project implementation. Short-term would be generally one year post treatment depending upon climate and moisture. Long-term would be a period of twenty years and would include implementation of all vegetation treatments including initial and maintenance burning.

Affected Environment

Northern goshawk habitat exists within and adjacent to the project area. All potential nesting and foraging habitat not overlapping with MSO PACs in the project area and a half-mile buffer was surveyed for northern goshawks in 2012 and 2013 according to Region 3 protocol. East-west transects were established, with survey points mapped every 260 meters (853 feet). Transects were 302 meters apart (989 feet), and points along each transect were offset from those along the adjacent transect(s), such that they occurred at the midpoint between survey points along the adjacent transect(s). A total of 824 call points were surveyed.

Three post-fledging family areas (PFAs) intersect the project area: Schultz, Orion and Thicket. Existing nest stands and alternate nest stands totaling 180 acres or more have been delineated for each of the three existing PFAs. All three PFAs were surveyed in 2013 with no detections. Table 122 summarizes the acres of PFAs and nest stands and Figure 72 (DLH) and Figure 73 (MM) display these habitats within the project area.

Table 122: NOGO PFA and Nest Stand Acres in the Project

PFAs Name	Total PFA Acres	PFA Acres within Project	Total Nest Stand Acres	Nest Stand Acres within Project
Thicket	650	423	181	50
Orion	777	391	190	21
Schultz Pass	612	393	183	100
Total	2039	1207	554	171

Other PFAs not listed above that are within the Action Area (project area plus a 0.5 mile buffer) include Bear.

Wildfire suppression has led to accumulations of dense, small-diameter, young ponderosa pine trees within and adjacent to the PFAs that pose an increased potential for catastrophic fire in northern goshawk habitat. These conditions also promote risk of disease, inhibit recruitment of important habitat features such as old-growth trees and snags, and restrict the conditions necessary to support a variety of prey species for northern goshawks.

Existing Vegetative Structural Stages (VSS) distribution within the PFA, including the alternate nest area, is predominately VSS 3 and 4. Outside the PFA the existing VSS distributions include VSS 3, VSS 4 and VSS 6 classes with VSS 3 and VSS 4 predominate.

Figure 72: Dry Lake Hills NOGO PFAs

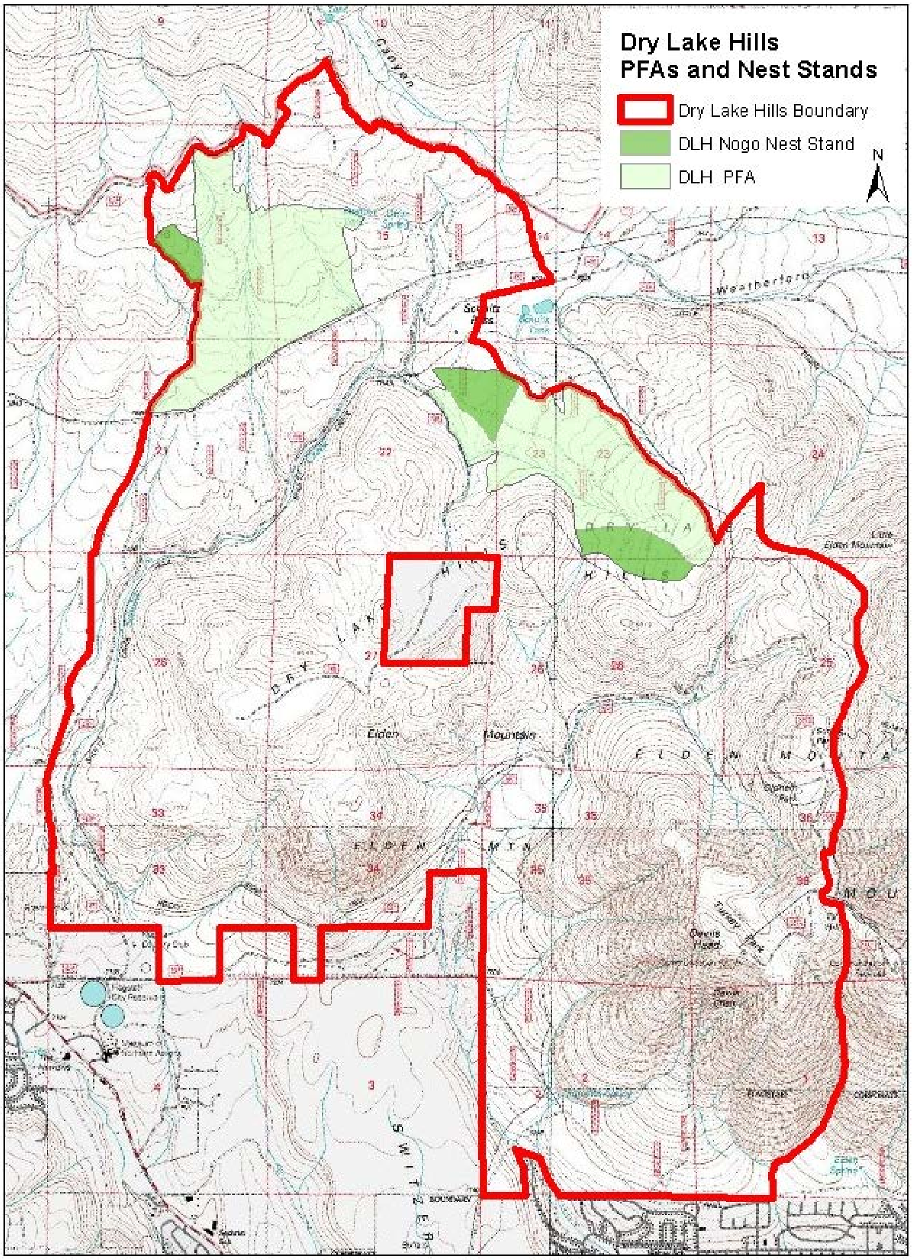
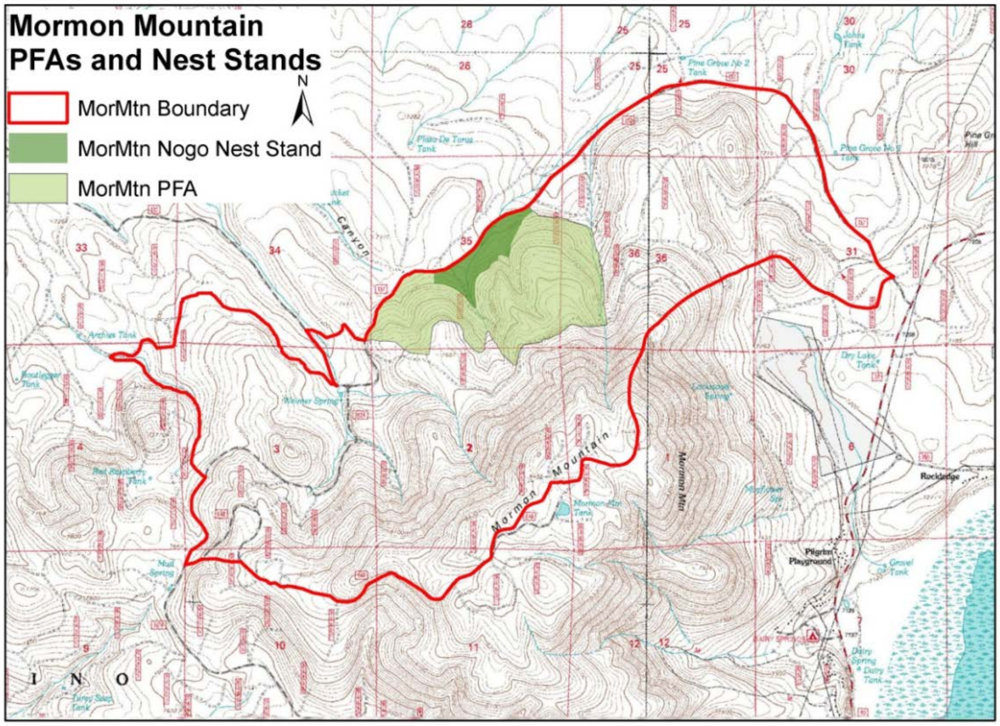


Figure 73: Mormon Mountain NOGO PFAs



Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on goshawks. However, dense forest conditions would still occur and the high fire hazard potential would continue to place goshawk habitat at risk with respect to stand replacing fire. Vegetative structural stage distributions as outlined in the Forest Plan and Management Recommendations for the Northern Goshawk in the Southwestern United States (Reynolds 1992) would never be attained.

Cumulative Effects

The cumulative effects boundary is the action area, defined as the project area and a one-half mile buffer, and includes effects for a period of 10 years beginning with implementation of the project. The No Action Alternative would maintain the current fire hazard to northern goshawk habitat and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place goshawk habitat and adjacent habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow, fuel continue to accumulate, and the impacts of climate change continue, thus continuing to have negative effects to northern goshawk.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Effects from Thinning and Prescribed Burning

Under Alternative 2, all treatments in goshawk habitats are designed to move toward the desired conditions as identified in the Northern Goshawk Management Guidelines (Reynolds et. al). Treatments are designed to maintain large snags, large logs and develop trees into the larger size classes. Typically snags would not be targeted for removal.

Under Alternative 2, approximately 178 acres would be treated within the Orion and Schultz PFAs with a prescription specifically designed to meet goshawk guidelines for PFAs, and 46 acres would be treated with a prescription specifically designed to meet the guidelines for nest stands. For LOPFAs, the alternative proposes 1,739 acres of ponderosa pine fuel reduction with 136 acres of hand thinning proposed. In areas where MSO habitat overlaps with goshawk habitat, MSO guidelines and desired conditions would take precedence. MSO treatments would move toward an uneven-aged condition; however they would likely exceed canopy cover standards so these acres would not move toward the desired structural stage distribution identified in the goshawk guidelines.

Treatments would alter VSS class distribution, changing the project area from one dominated by VSS 3 more toward the desired future condition, although still not meeting the desired future condition. Although the desired future condition would not be met immediately after implementation, the forest structure would be such that it would be moving towards it (Silviculture Specialist Report). Alternative 2 would offer higher quality foraging habitat over time due to improved habitat conditions for prey species.

Under Alternative 2, snags and large trees would be cut for cable corridors within the Orion PFA. All snags within the 60 acres proposed for harvesting by cable logging within the Orion PFA could be cut for safety reasons. There would be a loss of snags and downed logs during broadcast burning, although many would be protected using appropriate ignition and piling techniques, and lining of most snags and large logs (see Design Features). In addition, after burning, trees would be felled to replace logs burned up during prescribed fire to meet forest plan guidelines. Recruitment snags would be identified from live trees that exhibit defects ideal for wildlife. For example, trees with spiked tops, lightning strikes, mistletoe brooms, or fading crowns.

Reduction of snags and logs would have a negative impact on numbers of prey items, thus prey availability, for northern goshawk. The impact of this effect is expected to lessen in the long-term as snags are cut or fall and become logs; however the number of snags would continue to be in short supply due to an existing shortage of snags in some stands. The number of snags is expected to increase in the future as other trees grow, age, and die. Under this alternative, the resiliency of the area to withstand wildfire would improve due to the increase of crown base height and the reduced ground fuels. This alternative would have the most impact to dead and down woody material, gambel oak and snags.

There are potential direct effects from smoke. Smoke could affect nesting and feeding behavior. Avoiding burning near goshawk nesting areas during critical periods in the goshawks life cycle is important. Smoke accumulation during times when goshawks are incubating eggs and tending nestlings and fledgings could cause adults to leave the area; this in turn could cause reproductive failure for the year. Goshawk may be flushed from nest sites and/or change their foraging behavior due to smoke accumulation. This could cause goshawks to expend more energy and/or cause them to be detectable to predators during movements. Smoke from broadcast burning may disturb individual birds, although this would be a short-term effect (1-3 days) and of low intensity (drift smoke). Activities would be temporally and spatially separated, which would reduce overall effect and thus not affect the overall distribution of northern goshawk. Impacts from smoke would also be reduced by the coordination of timing and type of burning with wind direction, topography, time of year and distance to the goshawk nesting area.

Effects from Ground Disturbance

In addition to thinning and burning cable corridors and temporary road construction would be required to implement this alternative. Table 123 summarizes the acres of cable corridors, temporary roads and road relocations that are proposed in northern goshawk habitats.

Table 123: Alt. 2 - Cable Corridors (Acres) and Temporary Roads (Miles) in NOGO Habitat

PFA Name	Acres with Skyline/ Excaline Harvest Method in PFA	Acres with Skyline/Excaline Method in Nest Areas	Acres of Cable Corridor in PFA	Miles of Temp Road/Road Relocation in PFA	Miles of Temp Road/Road Relocation in Nest Areas
DLH	60	0	8	1.4/.9	.4/.5
Mormon Mtn.	0	0	0	.3/.3	.18/0
Total in PFAs	**60**	**0**	**8**	**1.7/1.2**	**.5/.5**
Outside of PFAs	DLH – 182* MM- 0	N/A	39*	DLH - 15.6/.23 MM – 3.51/.24	N/A

*Acres outside of MSO habitat.

Prescribed burning, thinning, temporary road construction and rehabilitation and corridor construction may indirectly affect the goshawk by changing the goshawks habitat structure (snags, downed logs, woody debris, vegetative structural stages, and dense canopy cover). In addition, the proposed activities may change the structure of goshawk prey species' habitat, affecting the abundance and composition of prey species. Although treatments, especially prescribed burning, may have adverse effects to prey species and their habitat in the short-term (generally one year, depending on climate and moisture), the proposed treatments may increase diversity of vegetative conditions, which would provide for a diverse prey base. Overall this would have an indirect beneficial impact on goshawks.

Effects from Noise Disturbance

Disturbance to raptors and in many instances can cause nest abandonment or changes in home range (Anderson et. al. 1990). Monitoring of motorized use on northern goshawk, however, has showed very little effect on individual goshawks, causing biologists to consider motor vehicle use a "minor stressor" (Slausen and Zielinski 2008). A noise study on goshawks conducted by Grubb et al. (1998) found that logging trucks did not elicit a discernible response when they passed within 0.3 mile (500 meters) of active nests. However, in an experimental study on the Kaibab NF, Grubb et al. (2012) found no evidence that the awareness of noise generated from logging trucks was correlated with actual negative effects to nesting northern goshawks. The observed response from nesting goshawks was limited to, at most, looking in the direction of the hauling road (Grubb et al. 2012). Noise disturbance could be caused by project implementation activities including thinning and burning, road construction and maintenance, hauling of logs to areas outside of the project, and road rehabilitation. Noise from mechanical treatments are not likely to directly affect nesting goshawks as no thinning would occur within nest stands during the breeding season. Implementation would be designed to limit disturbance in each PFA to two breeding seasons to reduce the duration of disturbance.

Cumulative Effects

There are additional indirect effects from vegetation modification activities occurring in other projects, including hazard tree removal for powerlines and highways, as well as tree removal for development of state and private lands. Grazing can temporarily reduce vegetative cover. The DLH area is currently deferred from grazing. The MM area is managed on deferred rotational and deferred rest rotation grazing systems designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. Generally, projects are designed to move toward the desired conditions for northern goshawks as identified in the Forest Plan. Cumulatively, these projects and activities may impact northern goshawks but are not likely to cause a trend toward listing or loss of viability.

Determination of Effect

Although there are many positive effects, Alternative 2 would also have some negative effects to northern goshawk. Alternative 2 would largely benefit goshawks by improving habitat and moving toward a more uneven-aged structure with greater understory composition and reduced fire behavior. However, the loss of snags within drainages in the Orion PFA for corridor construction and the loss of snags in LOPFAs would have a minimal negative impact to important habitat components. Hauling activities on main haul routes could occur within 0.3 mile of nest stands, potentially impacting nesting goshawks within the Schultz and Thicket PFAs. Thinning activities in PFAs during the breeding season could impact nesting however; disturbance would be limited to two breeding seasons. Project activities may impact northern goshawks but are not likely to cause a trend toward listing or loss of viability.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Effects to northern goshawk habitat would be similar to those described under Alternative 2 in that the treatments and desired conditions would be the same; however the distribution of snags and large trees would be more consistent due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. Helicopter logging would occur in the Orion PFA under this alternative, which would remove all snags on steep slopes within the 39 acres of the PFA. In addition, snags would also be removed in areas LOPFAs where helicopter logging is proposed. A design feature would require biologists to identify patches of snags up to 10 acres in size to allow for retention of some snags in these areas. Not taking into account these patches, there would be approximately 1,251 acres of LOPFAs where all snags could be removed to provide for safety.

The use of helicopter logging would require landings where trees are processed at the landing area with a processor. Helicopter paths would be reviewed to exclude flights over occupied nest locations during the northern goshawk breeding season (see Design Features specific to Alternative 3).

Under Alternative 3, there would be fewer miles of temporary roads needed within PFAs and LOPFAs than for Alternative 2 (see Table 123 for Alternative 2 and Table 124 for Alternative 3), reducing short term ground disturbance in these habitats.

Table 124: Alt. 3 - Miles of Temporary Roads in NOGO Habitat

Area	Miles of Temp Road/Relocated Road in PFAs	Miles of Temp Road/Relocated Road in Nest Areas	Acres Harvested by Helicopter
Dry Lake Hills	1.1/.9	.2/.5	39
Mormon Mtn.	.3/.3	.2/0	0
Total in PFAs	.9/1.2	.4/.5	39
Outside of PFAS	DLH – 11.1/.2 MM – 2.4/.2	N/A	1,251

Cumulative Effects

The cumulative effects are the same as in Alternative 2.

Determination of Effect

Although there are many positive effects, Alternative 3 would also have some negative effects to northern goshawk. Alternative 3 would largely benefit goshawks by improving habitat and moving toward a more uneven-aged structure with greater understory composition and reduced fire behavior. However, the loss of snags within the Orion PFA for safety purposes in areas harvested by helicopter would have a minimal negative impact to important habitat components. Helicopter operation could occur within the Orion PFA during the breeding season. Hauling activities on main haul routes could occur within 0.3 mile of nest stands, potentially impacting nesting goshawks within the Schultz and Thicket PFAs. Project activities may impact northern goshawks but are not likely to cause a trend toward listing or loss of viability.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Alternative 4 would treat 73 acres less in PFA habitat than the other action alternatives. This alternative would not include treating within the Orion PFA; only those treatments previously approved through the Jack Smith Schultz Forest Health and Fuels Reduction project would occur. There would also be 4,100 acres that would not be treated, and therefore those acres would not be developing toward a more uneven-aged structure.

<u>Effects from Ground Disturbance</u>
Ground disturbance would be primarily from mechanical operations, construction of landings and temporary roads. Table 125 summarizes the miles of temp roads and road relocations in northern goshawk habitats.

Table 125: Alt. 4 - Miles of Temporary and Relocated Roads in NOGO Habitat

PFA Name	Miles of Temp Road/Relocated Road in PFAs	Miles of Temp Road/Relocated Road in Nest Areas
Dry Lake Hills	.5/.9	.22/.5
Mormon Mtn.	.3/.3	.2/0
Total in PFAs	.9/1.2	.4/.5
Outside of PFAS	DLH – 9.1/.2 MM – 2.4/.2	N/A

Alternative 4 would not require cable corridors, cable or helicopter logging to accomplish thinning treatments reducing the site specific loss of snags. Less area would be treated mechanically requiring less ground disturbance than the other action alternatives. The number of temporary roads would also be less than the proposed action resulting in less short term disturbance to prey habitat.

<u>Disturbance from Project Implementation</u>
This alternative would have the least amount of disturbance from project implementation. There would be no disturbance from helicopter operations, steep-slope machinery or cable logging operations. Although the same haul routes would be used, fewer vehicle trips would be required and the duration of the project would be shorter than the other action alternatives.

Cumulative Effects
Cumulative effects are the same as Alternative 2 and 3, but to a lesser degree due to fewer acres being treated**.**

Determination of Effect
Although there are many positive effects, Alternative 4 would also have some negative effects to northern goshawk. Alternative 4 would largely benefit goshawks by improving habitat and moving toward a more uneven-aged structure on treated acres with greater understory composition and reduced fire behavior. Hauling activities on main haul routes could occur within 0.3 mile of nest stands during the breeding season, potentially impacting nesting goshawks within the Schultz and Thicket PFAs. Project activities may impact northern goshawks but are not likely to cause a trend toward listing or loss of viability.

American Peregrine Falcon
Analysis Methods
The following evaluation criteria were used to compare environmental consequences for all alternatives:
- Prey species habitat
- Disturbance from project implementation

Affected Environment

The essential habitat for peregrine falcon includes rock cliffs for nesting and a large foraging area. Suitable nesting sites on rock cliffs have a mean height of 200 to 300 feet. The MM area lacks steep cliff sites potentially suitable for nesting by this species. The DLH area includes one eyrie within the project, northwest of the Devils Head communication facility, and another approximately 0.6 mile east of the project area on the southern face of Mt. Elden. Peregrines prey mainly on birds found in wetlands, riparian areas, meadows, parklands, croplands, mountain valleys, and lakes within a 10 to 20 mile radius from the nest site. Peregrines likely forage in the DLH area. Prey species include bats, mammals and birds. The peregrine breeding season is from March 1 to August 15.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Under the No Action Alternative, there would be no direct or indirect effects to peregrines. There would be no change to the prey species base, and no change in falcon hunting patterns within associated forest structure.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to peregrine falcon habitat and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place peregrine falcon habitat and adjacent habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow, fuel would continue to accumulate, and the impacts of climate change would continue to affect forest health, thus continuing to have negative effects to peregrine falcon.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Peregrines could be directly impacted if project activities disturb breeding birds. No treatments are proposed at the peregrine eyrie within the project, and direct effects from thinning or burning are not expected because no thinning or burning activities would take place within one-quarter mile of an active eyrie during the breeding season (see Design Features). No direct or indirect effects are expected to the East Elden eyrie due to the distance from the project and the location of the eyrie in an area where smoke is not anticipated to settle.

Under Alternative 2, there would be indirect effects from the modification of vegetation. Thinning could adversely affect the prey base on a short-term basis by impacting individuals of prey species due to disturbance of prey species' habitat and harm from fire. However, over the long- term, an increased diversity of vegetative structural stages and improved understory vegetation would increase prey species, resulting in indirect beneficial impacts. Thinning of the forest would increase sight distance for foraging peregrine falcons, which facilitates hunting conditions, resulting in an indirect beneficial impact.

Cumulative Effects

Under Alternative 2, there would be an additive effect from activities that modify vegetation. Other projects where thinning occurs could affect the prey base on a short-term basis by impacting individuals of prey species due to disturbance of prey species' habitat and harm from fire. However, projects would be implemented at different times and different locations, thus disturbances to the prey base would be minimized. An additional cumulative effect includes unmanaged climbing in areas where peregrine falcons are known to nest. In the last ten years, rock climbing has doubled, which could result in peregrine nesting success. Cumulatively, these projects and activities may impact peregrine falcons but are not likely to cause a trend toward listing or loss of viability.

Determination of Effect

The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Effects to peregrine falcon habitat are similar as those discussed for Alternative 2 in that the treatments and desired conditions would be the same; however the distribution of snags and large trees would be more consistent due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery.

As a result of harvesting by helicopter, snags would be removed from 972 acres of foraging habitat, which could affect the distribution of bats, birds and small mammals. However this would have little impact to peregrines due to the large area available for foraging in the 10-20 mile radius of the known nest sites.

The use of helicopter logging would require landings where trees are processed at the landing area with a processor. Ellis and Ellis (1991) indicate that buffer zone of 500-m (1638ft) or less for helicopter overflights would minimize flush response and any potential effects on nesting habitat. The recommendation of no activities within one-quarter mile of an occupied eyrie would include helicopter use to limit disturbance to nesting birds. An implementation guide would be developed prior to implementation to ensure helilandings and helicopter flight patterns limit disturbance to nesting peregrines (see Design Features).

Cumulative Effects

Cumulative effects are the same as Alternative 2.

Determination of Effect

The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Effects to peregrine falcon habitat would be similar as the other action alternatives; however there would be a total of 3,459 acres of vegetation treatment in peregrine falcon habitat within the DLH area, 2,504 acres less than the other action alternatives. The distribution of snags and large trees would be more consistent due to the absence of cable corridors and areas harvested by cable or helicopter logging.

Under Alternative 4, there would be less foraging habitat with improved vegetative structural stages and understory diversity, although there would still be an indirect beneficial affect for peregrines.

Cumulative Effects

Cumulative effects are the same as Alternative 2, though to a lesser degree as fewer acres would be treated.

Determination of Effect

The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Navajo Mogollon Vole

Analysis Methods

The following evaluation criteria were used to compare environmental consequences for alternatives:

- Amount and distribution of habitat
- Disturbance from project implementation

Affected Environment

Navajo Mogollon voles occupy meadows and riparian areas above the Mogollon Rim associated with ponderosa pine or other coniferous forests. They also occur within forested areas where tree densities are low. They rely on grasses and other herbaceous vegetation for food or cover. Vole runways have not been documented in the project area; however, vole populations likely occur in the project area. Potentially suitable habitat within the project area is currently 60 acres of grassland habitat, and any openings within the ponderosa pine and mixed conifer.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects. Although habitat would continue to be provided for this species, most of the forested area within the project is currently in a moderately-closed to closed condition, which provides low quality habitat for the Mogollon vole. Under the No Action Alternative, openings would not be created and canopy closure would not be reduced, thus there would no benefits to the vole. Favorable habitat would decrease over time as conifers encroach into meadows and canopy closure increases, resulting in an indirect adverse effect. In addition, high fire hazard potential would persist, and a large crown wildfire event would have the potential to affect many individuals.

Loss of vegetative cover removes food and shelter for voles and this alternative would have the highest level of loss or degradation in grasslands and vegetation types used by this vole.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to vole habitat and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place vole habitat and adjacent habitat at risk of stand-replacing fire. Climate change would continue to contribute to this hazard. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have a negative effect on Navajo Mogollon vole.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, thinning and broadcast burning and ground disturbing activities may disturb individual voles, resulting in direct adverse effects. Broadcast burning, harvest activities, temporary road construction and corridors would result in the removal of cover and food; it is anticipated that grasslands, open areas and rehabilitated roads would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Additionally, such activities would occur across the project area at different times; thereby reducing impacts to this species. In addition, the effect would be short-term, generally one year, depending on climate and moisture. The reduction of dense forest canopy and increased growth in the herbaceous vegetation on the forest floor would result in indirect beneficial impacts to the vole. Forest conditions after treatment would improve vole habitat within the project area.

Temporary roads construction would disturb four acres of grassland habitat, and the designation of use for administrative purposes would continue to permanently reduce the quality of this unique habitat for voles.

This alternative would provide the most habitats for voles than the other alternatives due to the proposed treatments in mixed conifer and ponderosa pine opening the canopy, and also the creation of cable corridors, which would provide additional food and cover for voles.

Cumulative Effects

Recreation (e.g., hiking, biking, and camping) and road travel pose an adverse effect to voles due to soil and vegetation disturbance and soil compaction. This would combine with the Mount Elden Dry Lake Hills Recreation Planning Project’s proposed action to reduce vole habitat. Recreational activities would continue to occur in the project area, resulting in decreased habitat for voles; however, forest management practices that promote herbaceous growth could lead to increased vole populations. There are additive effects of reduction of understory vegetation by livestock grazing in the MM area. Livestock grazing would combine with short-term loss of understory vegetation from burning and harvest activities. The MM area is managed on a deferred rotational and rest rotational grazing system designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative effects. Development of private and state land has the greatest potential impact to vole habitat. Cumulatively, these projects and activities may impact the Navajo Mogollon vole but are not likely to cause a trend toward listing or loss of viability.

Determination of Effect

Although there are many positive effects, Alternative 2 would have some short term negative effects to Mogollon vole. The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Effects to Mogollon vole habitat are similar to those described for Alternative 2 in that the treatments and desired conditions would be the same; however there would be fewer openings due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. No cable logging would occur under this alternative, which would reduce the need to remove the large trees and logs on steep slopes and also the need to create corridors. Large snags cut for safety would be left on site, improving habitat. As with Alternative 2, this alternative would permanently impact four acres of grassland habitat with construction of a temporary road and the designation to maintain it for administrative use.

This alternative would provide more vole habitat than Alternative 1 but less than Alternative 2 as additional habitat would not be produced by creating corridors.

Cumulative Effects

Cumulative effects are the same as Alternative 2.

Determination of Effect

Although there are many positive effects, Alternative 3 would have some short term negative effects to Mogollon vole. The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Effects to Mogollon vole habitat are similar to those discussed for Alternatives 2 and 3; however there would be fewer openings due to the absence of proposed cable corridors. This alternative would treat 3,080 acres less habitat than the other action alternatives, including seven less acres of grassland treatment, and so providing the least habitat improvement for this vole. As discussed under the other action alternatives, Alternative 4 would permanently impact four acres of grassland habitat with construction of a temporary road and the designation to maintain it for administrative use.

Cumulative Effects

Cumulative Effects

Cumulative effects are the same as Alternative 2 and 3.

Determination of Effect

Although there are many positive effects, Alternative 4 would have some short term negative effects to Mogollon vole. The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Allen's Lappet-browed Bat, Pale Townsend's Big-eared Bat

Analysis Methods

The following evaluation criteria were used to compare environmental consequences for all alternatives:

- Amount and distribution of habitat
- Disturbance from project implementation

Affected Environment

Surveys of two tanks within the project area were completed the summer of 2013 with eleven different bat species captured. Allen's lappet-browed bats and Pale Townsend's big-eared bats were not detected during these efforts. Townsend's big-eared bats were documented to use caves on the Flagstaff and Red Rock Districts; however no roosts were located within the project area. There are two documented caves within the DLH area; however no bat use has been recorded. Townsend's big-eared bats were not documented using ephemeral trees/snags as roosts on the Coconino, although they likely do.

Suitable habitat for Allen's lappet-browed bat would be large snags used for roosting and foraging habitat including areas with water and insects. The presence and regeneration of snags and/or dead and dying trees with loose bark, dispersion of habitat types and structure within habitat including openings, montane meadows, or openings with wet soils with diverse vegetative herbaceous ground cover and species composition to support prey items. Pools, tanks, and openings with wet ground also support prey. Potential habitat for Allen's lappet-browed bats and Pale Townsend's big-eared bats include approximately 6,260 acres of ponderosa pine, 4,169 acres of mixed conifer and 60 acres of grassland within the FWPP.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects to these bat species. Low-quality habitat would still exist for these species; however, the high fire hazard potential would persist, and a large crown wildfire event could have the potential to affect individuals, resulting in indirect adverse effects. Under the No Action Alternative, there would be no disturbance and no direct effects.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to bat habitat and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions and the effects of climate change would continue to place bat habitat and adjacent habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have a negative effect to Allen's lappet-browed and Pale Townsend's big-eared bats.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, thinning and broadcast burning activities could potentially disturb bats if they are roosting in snags within the project area. Allen's lappet-browed bats rely on snags for ephemeral roosts and are thought to select taller snags closer to forest roads as maternity roosts, and so are vulnerable to increased harvest of these structures along roads, (Solvesky and Chambers 2009, Wisdom and Bate 2008).

Roughly 241 acres of potential roosting habitat would be denuded by cable corridors under this alternative. This alternative would result in the greatest decrease in snags by cutting cable corridors, removing snags for safety and burning on the most acres. These effects would primarily result in effects of localized extent. The physical appearance of corridors may provide similar habitat characteristics of roads for bats and may provide additional habitat for this species. The reduction of dense forest canopy and creation of edges by creating corridors would increase growth in herbaceous vegetation on the forest floor, resulting in indirect beneficial impacts to bats. Maintaining or creating snags post-implementation in key areas along openings and corridors may provide additional habitat for this bat. Forest conditions after treatment would improve bat habitat within the project area.

Cable logging requires that all hazard trees are removed from the entire area that is cable logged to provide for safety of personnel on the ground outside of protected machinery. A design feature requires biologists to identify patches of snags up to 10 acres in size to allow for retention of some snags in these areas. Not taking into account these patches, there would be approximately 1,049 acres in potential bat roosting habitat where all snags could be removed to provide for safety.

Overall, the project is designed to grow trees into larger size classes, providing more recruitment snags over the long term. Snag densities on a project-level scale would not change considerably. Alternative 2 would reduce bat roosting habitat, but at the same time would create more improved foraging habitat than Alternative 4. Snags in key areas such as south and southwestern slopes in the DLH would not change for any of the alternatives as no treatments are proposed in these areas.

Alternative 2 is expected to result in a slight short-term decrease in snags followed by an increase over the long-term at the project level, but with a long-term decrease of snags in corridors and areas harvested by cable logging. Snags and recruitment snags would be removed to create corridors and snags would be removed in areas harvested by cable logging. However this loss of snags is not expected to affect the overall distribution of Allen's lappet-browed bats and Pale Townsend's big-eared bats on the forest.

Broadcast burning would result in the removal of cover and food; however it is anticipated that meadows and open areas would rebound afterwards with more vigorous herbaceous vegetation and healthier understory habitats.

Under Alternative 2, there would be indirect effects from the modification of vegetation. Thinning, burning, construction of temp roads and corridors could adversely affect the prey base on a short-term basis by impacting individuals of prey species due to disturbance of prey species' habitat and harm from fire. However, over the long- term, an increased diversity of vegetative structural stages and improved understory vegetation would increase prey species, resulting in indirect beneficial impacts.

Cumulative Effects

Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. The Dry Lake Hills has been deferred from grazing and has not been grazed by cattle in over 10 years. The Mormon Mountain project area is managed on deferred rotational and deferred rest rotation grazing systems designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. Other projects that may add to the loss of snags include powerline maintenance and removal of hazard trees along roads and trails. Cumulatively, these projects and activities may impact Allen's lappet-browed bats or Pale Townsend's big-eared bats, but are not likely to cause a trend toward listing or loss of viability.

Determination of Effect

Although there are positive effects, Alternative 2 would also have some negative effects. Alternative 2 would largely benefit Allen's lappet-browed bats and Pale Townsend's big-eared bats by improving understory diversity and increasing prey habitat across the project. There would be a loss of snags and recruitment snags in concentrated areas where corridors are constructed and areas are harvested by cable logging; however at a project level, snag loss would be minimal. The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Effects to Allen's lappet-browed bat and Pale Townsend's big-eared bat habitats are similar as under Alternative 2; however the distribution of snags and large trees would be more consistent due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. There would be 972 acres harvested by helicopter logging in Allen's lappet-browed and Pale Townsend big-eared bat habitat, which would reduce snags on steep slopes and reduce potential roosting habitat. This loss of snags is not expected to affect the overall distribution of these bat species on the forest.

Alternative 3 would provide slightly less bat roosting habitat than Alternative 1 and more than Alternative 2 as no cable corridors would be required. On the other hand, this alternative would create less foraging habitat than Alternative 2 with reduced openings for corridors.

Cumulative Effects

Cumulative effects are the same as Alternative 2.

Determination of Effect

The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

This alternative would treat approximately 3,118 fewer acres of habitat than the other actions alternatives, providing the least habitat improvement for these bat species by limiting the ability to create openings within the forest canopy to provide for more understory diversity in both the ponderosa pine and mixed conifer habitats. Cable and helicopter logging would not occur, reducing the number of snags needed to be cut for safety purposes and thereby reducing the potential for site specific impacts.

Cumulative Effects

Cumulative effects are the same as Alternative 2 and 3, but to a slightly lesser degree as fewer acres would be treated.

Determination of Effect

Although there are mostly positive effects, Alternative 4 would also have some negative effects. Alternative 4 would largely benefit Allen's lappet-browed bats and Pale Townsend's big-eared bats by improving understory diversity and increase prey habitat across the project where treatments are proposed. The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Spotted Bat

The following evaluation criteria were used to compare environmental consequences for alternatives:

- Amount and distribution of habitat
- Disturbance from project implementation

Affected Environment

Roost site characteristics are poorly known for this species, but limited observations suggest that spotted bats roost singly in crevices, with rocky cliffs and surface water characteristic of localities where they occur. It has been found from low desert areas in southwestern Arizona to high desert and riparian habitat in the northwestern part of the state. It has also been found in conifer forests in northern Arizona (Kaibab Plateau) and other western states. There are no roost locations known to occur on the Forest. This species is a habitat generalist and could forage across the entire Forest.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Under the No Action Alternative, there would be no disturbance and no direct effects. Low-quality foraging habitat would still exist for this species; however, the high fire hazard potential would persist, and a large crown wildfire event could have the potential to affect individuals, resulting in indirect adverse effects.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to bat habitat and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place bat habitat and adjacent habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have a negative effect to spotted bat.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, disturbance to the spotted bat from thinning and prescribed burning activities is highly unlikely. Isolated occurrences of disturbance may impact individuals but because this bat roosts singly, proposed activities would not have an impact on an entire colony of spotted bats.

Broadcast burning would result in the removal of cover and food; however it is anticipated that meadows and open areas would rebound afterwards, with more vigorous herbaceous vegetation and healthier understory habitats. Indirect effects would result from vegetation modification activities such as thinning and prescribed burning and ground disturbing activities (cable corridors, temporary roads and landings). These activities would disturb or remove understory vegetation, subsequently reducing availability to insects. These effects would be short-term and would be minimized due to activities being temporally and spatially separated. In contrast, reducing canopy closure, removing trees in corridors and creating edges, restoring meadows and broadcast burning would encourage the development of understory vegetation, increasing availability of food for the bat over the long-term.

Cumulative Effects

The cumulative effects area considered includes the project area and all projects (past, present and reasonably foreseeable) that are within the project area that have the potential to impact spotted bats were analyzed. Ungulate grazing within the project area reduces understory vegetation, which reduces plant availability to adult insects, a primary food source. Approximately half of the project area is currently not being grazed by livestock and the remainder is managed on a rotational grazing system designed to allow forage a chance to recover from livestock grazing, reducing the potential for cumulative impacts. Cumulatively, these projects and activities may impact spotted bat but are not likely to cause a trend toward listing or loss of viability.

Determination of Effect

Although there are mostly positive effects, Alternative 2 would also have some short-term negative effects from disturbance during implementation. Alternative 2 would largely benefit spotted bat by improving understory diversity and increase prey habitat across the project. The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Effects to spotted bat habitat are similar as under Alternative 2; however the distribution of snags and large trees would be more consistent due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. Helicopter logging would be used on steep slopes which would require the removal of snags on approximately 972 acres of spotted bat foraging habitat, all within the DLH area.

Cumulative Effects

Cumulative effects are the same as Alternative 2.

Determination of Effect

Although there are mostly positive effects, Alternative 3 would also have some negative effects. Alternative 3 would largely benefit spotted bats by improving understory diversity and increase prey habitat across the project. The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Effects to spotted bat habitats are similar as Alternative 2 and 3; however there would be no helicopter or cable logging, so there would be no added effect from the loss of snags within these areas.

Cumulative Effects

Cumulative effects are the same as Alternative 2 and 3, but to a slightly lesser degree as fewer acres would be treated.

Determination of Effect

Although there are mostly positive effects, Alternative 4 would also have some negative effects. Alternative 4 would largely benefit spotted bat by improving understory diversity and increase prey habitat across the project. The project's activities may impact individuals but is not likely to cause a trend toward listing or loss of viability.

Northern Leopard Frog

The following evaluation criteria were used to compare environmental consequences for alternatives:

- Impacts to potential habitat

Affected Environment

There are no known existing or historic locations of northern leopard frogs within the project, though livestock tanks in the project area provide potential habitat for northern leopard frogs throughout the year. According to the Coconino National Forest Natural Resource Information System database (NRIS), there are three waters with potential habitat for leopard frogs: Schultz Tank, Pushout Tank, and Weimer Spring. Dry Lake Tank, within the project area but located on private land, may provide additional habitat. Because of the high potential for northern leopard frogs near the Mormon Lake area, tanks and springs within one-half mile of the Mormon Lake project and within the project's watershed were surveyed in 2013. Of the 44 tanks surveyed, one tank, within a half mile of the MM area, was found to have northern leopard frogs present.

Chytrid fungus and non-native predators have been identified as major mechanisms causing declines in northern leopard frogs across their range.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Under the No Action Alternative, habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on northern leopard frog. However, dense forest conditions would still occur and the high fire hazard potential would persist. Large crown-wildfires could adversely affect potential habitat by destroying understory and overstory vegetation. As a result overland flow would increase, and soil erosion would increase with potentially high sediment loads. Water quality would be adversely affected on a wide-scale basis, and potentially in occupied habitat within the Mormon Mountain/Lower Lake Mary Watershed, resulting in indirect adverse effects.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to northern leopard frog habitat and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place frog habitat and adjacent habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have an adverse effect to northern leopard frog.

Effects Common to All Action Alternatives

Direct & Indirect Effects

Under Alternatives 2, 3 and 4, there would be no direct effects to northern leopard frog eggs, larvae, or adults from project activities as leopard frogs are not present within the project, and implementation of soil and watershed best management practices (BMPs) would curtail soil erosion and minimize inflow into potential leopard frog habitat. Indirect effects would be from reducing the potential for stand-replacing wildfire within the MM area and thereby reducing the potential of adverse impacts to leopard frog habitat within the Lower Lake Mary Watershed.

Cumulative Effects

Alternatives 2, 3 and 4 would add to other past and reasonably-foreseeable projects within the Lower Lake Mary Watershed that have or are planned to reduce the potential for stand-replacing wildfires, thereby reducing the potential for adverse effects from increased overland flow and soil erosion with potentially high sediment loads in potential and occupied habitat within the Lower Lake Mary Watershed, resulting in indirect beneficial effects.

Determination of Effect

The action alternatives would largely benefit northern leopard frogs by reducing the potential for stand replacing wildfires, thereby reducing the potential adverse effects to habitat. Although project activities could cause increased soil erosion with potential sediment loads in potential and occupied habitat, BMP's would curtail soil erosion and minimize effects. The project's activities may impact northern leopard frog but would not lead to a trend to listing or loss of viability.

Snags and Logs

Snags and logs are important elements of the structure and function of ponderosa pine, mixed conifer and aspen, and are also important to bird and small mammal communities.

Analysis Methods

The following evaluation criteria were used to compare environmental consequences for alternatives:

- Snag and log densities
- Snag and log locations

Forest Plan Standards and Guidelines

For areas outside of PFAs (snags are 18" or larger dbh and 30'or larger in height, logs are 12" dbh and at least 8' in length)

- Ponderosa pine - Leave at least 2 snags, 3 downed logs, and 5-7 tons of woody debris per acre.
- Mixed conifer, Spruce - fir – Leave at least 3 snags, 5 downed logs and 10-15 tons of woody debris per acre.
- Aspen- Retain trees greater than 12 inches diameter at breast height (dbh) and nest trees. Within 10K blocks at least 50 percent of the forested land meets 2 snags per acre. In high priority areas including both edge habitats adjacent to meadows or water and interior stands, manage for an average of 2.8 snags per acre. Provide for down woody debris.

For areas within MSO Recovery or Protected habitat:

- Retain substantive amounts of snags 18 inches in diameter and larger and down logs over 12 inches midpoint diameter

Affected Environment

Project (Ecosystem Management Area)

In 2002 the Forest estimated that trends for snags in ponderosa pine habitats were probably declining (USDA Forest Service 2002a). However, a recent study by Ganey and Vojta (2007) conducted on the Coconino and Kaibab National Forests within the ponderosa pine and mixed conifer habitats indicates that, at least in the short term, snag numbers are increasing and would continue to increase and densities of large snags would increase (Ganey and Vojta 2007). Despite these increases, densities of large snags (greater than 18 inches dbh) would remain below Forest Plan guidelines. The models used by Ganey and Vojta provide a useful tool for modeling snag dynamics at a landscape scale but are not suitable for modeling snag dynamics at the stand level. Snag and log data were collected for both the FWPP project areas. Snags greater than 12 inches dbh and greater than 18 inches dbh meet Forest Plan standards for the project area.

Cover Type (Mid-Scale)

At the mid-scale level, snags greater than 12 inches dbh meet Forest Plan standards in all cover types across the FWPP area; however, snags greater than 18 inches dbh are below standards in the mixed conifer and aspen cover types in the DLH and the ponderosa pine cover type in MM. In ponderosa pine, the average density of snags greater than 18 inches dbh per acre in is 2.1 in the DLH and 0.7 in MM. In mixed conifer, the average density of snags greater than 18 inches dbh per acre is 2.4 in DLH and 9.3 in MM. For aspen, the average density of snags greater than 18 inches dbh per acre is 0.1 in the DLH area; there is no aspen cover type on MM.

Site/Stand Level (Small Scale)

Snag data was not collected for every stand in the project; however, the data collected shows that not all stands meet the Forest Plan guidelines.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Table 126 below summarizes the existing snags (Alt.1) and the change in snag densities for each alternative immediately after treatment.

Table 126: Snags/acre ≥ 18" diameter breast height (dbh) and ≥ 12" DBH immediately after treatment by alternative

	Description	Snag Size	Alt. 1	Alt. 2	Alt. 3	Alt. 4
Project Area	Dry Lake Hills	≥12”	6.4	5.1	5.1	5.5
		≥18”	2.2	2.2	2.1	2.2
	Mormon Mountain	≥12”	10.6	10.1	10.5	10.8
		≥18”	3.6	3.5	3.7	3.7
Cover Type Dry Lake Hills	Ponderosa Pine	≥12”	3.6	3	3.2	3.3
		≥18”	2.1	1.9	1.9	1.8
	Mixed Conifer	≥12”	8.8	7.4	6.8	8.4
		≥18”	2.4	2.4	2.3	2.6
	Aspen	≥12”	19.9	19.9	19.9	19.9
		≥18”	.1	.1	.1	.1
Cover Type Mormon Mountain	Ponderosa Pine	≥12”	3.9	4.6	4.6	4.6

	Description	Snag Size	Alt. 1	Alt. 2	Alt. 3	Alt. 4
		≥18”	.7	.7	.7	.7
	Mixed Conifer	≥12”	23.4	20.9	22.2	22.4
		≥18”	9.3	8.4	9	9
	Wet Mixed Conifer	≥12”	25.8	21	21.4	25.8
		≥18”	12.1	11	11.2	12.1

Under the No Action Alternative, there are no treatment effects. The high fire hazard potential in the project area would persist. In the event of a large crown-wildfire, widespread loss of snags and logs would occur. Generally, snags remaining after a crown-wildfire would have decreased longevity and value to wildlife. High tree densities would remain, limiting growth of large diameter trees and thereby limiting replacement snags and logs.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to snags and logs within the project and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place wildlife cover at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Snags and logs are important elements of the structure and function of ponderosa pine, mixed conifer and aspen, and are important to bird and small mammal communities. Losses of snags and logs from prescribed burning in ponderosa pine and mixed conifer habitats would occur under this alternative; however, snags continue to fall and provide new logs on the forest floor. Fire damaged trees and recruitment snags would provide additional snags following prescribed fire.

Project Area (Landscape Scale)

Under Alternative 2, both project areas would meet Forest Plan guidelines immediately after treatment. Large snags (greater than 18 inches dbh) fall slightly below standards in MM 20 years post-treatment. At 40 years post-treatment snags begin to decline slightly for both project areas.

Cover Type (Mid-Scale)

Snags would continue to exceed standards and guidelines post-treatment in MM and would be slightly reduced in DLH.

For ponderosa pine, snags greater than 18 inches dbh would be reduced to just below Forest Plan guidelines immediately after treatment in the Dry Lake Hills, with no change in large snag densities in the ponderosa pine in Mormon Mountain.

For aspen, the post-treatment density of snags would remain the same immediately after treatment and 20 years post-treatment. Within 40 years there would be no aspen snags remaining due to loss of snags with no immediate recruitment of larger size classes.

None of the cover types currently meet the Forest Plan standard for snags at the mid-scale level. There may be an additional loss of snags from burning; however, burning may also create new snags. Overall the project is designed to grow trees into larger size classes providing more recruitment snags over the long term.

Site/Stand (Small Scale)
There would be a direct effect of loss of snags from corridors and a loss of snags from areas harvested by cable logging. In ponderosa pine there would be a loss of snags on approximately 378 acres, and in mixed conifer there would be a loss of snags on approximately 912 acres. Design features have been incorporated to provide for patches of snags up to 10 acres in size to serve as reserve areas within these units. Additionally, some snags cut for safety purposes would be left on site to provide increased logs where needed. This loss of snags would not meaningfully affect the average snags per acre on a landscape or project level, but it would have noticeable impacts on a site specific level. In addition, there would be a direct effect of loss of snags and logs during initial entry and maintenance prescribed fire; however, with the anticipated mortality associated with prescribed burning snags and logs would be created to offset the direct effect (Fuels and Fire Specialist Report). These effects would be minimized since snags necessary to meet wildlife management objectives would be fire-lined or replaced. Loss of large logs would be minimized though ignition techniques and possibly fire-lining.

Although fire can have a detrimental effect on pre-burn snags, it can cause live trees to die and become snags after fire. With the retention of yellow pine trees, recruitment snags and old growth recruitment site management, some trees would in time naturally convert to snags. This natural conversion of snags to logs would contribute to additional numbers of snags and logs on the ground. The less competition between trees for moisture, nutrients, and sunlight, the larger they would grow prior to becoming snags. Larger diameter snags (greater than 18 inches dbh) are necessary to meet Forest Plan guidelines. Recruitment snags would be identified and retained from live trees that exhibit defects ideal for wildlife. For example, trees with spiked-tops, lightning strikes, mistletoe brooms, or fading crowns.

Alternative 2 would have the greatest impact to snags on a site/stand level.

Cumulative Effects for All Action Alternatives

The cumulative effects boundary is the FWPP project area. Past timber harvest and illegal fuelwood activities have reduced snag densities to below Forest Plan recommendations in some stands. Snags were removed during forest harvest because of potential fire and safety hazards, and many thought they had poor aesthetic value and were indicative of an unhealthy forest. Snags are especially vulnerable to bark beetle infestation, illegal fuelwood cutting, and ongoing projects that remove hazard trees such as APS hazard tree removal along powerlines and telephone lines.

The past outbreak of bark beetle infestations has killed trees thus creating snags, therefore increasing snags in pockets across the landscape. However, insect attacks result in rapid deterioration of snags, decreasing their longevity and value to wildlife. Some bug-killed trees would topple over and become downed logs. Bug killed logs would compensate for a portion of the loss of large logs due to burning activities.

Other fuels reduction and forest restoration project are designed to develop larger trees which provide recruitment for large snags. These projects would combine with FWPP to provide for snags in the long term across the landscape.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Project (Landscape) and Cover Type (Mid-scale)
Landscape scale and mid-scale effects to snags are similar to those described under Alternative 2 in that the described treatments and desired conditions would be the same and the same number of acres would be treated. However effects to snags and logs differ between alternatives at the stand level.

Project (Landscape)
Under Alternative 3, both project areas would meet Forest Plan guidelines immediately after treatment. Large snags (greater than18 inches dbh) would fall slightly below standards in MM 20 years post-treatment. At 40 years post-treatment, snags would begin to decline slightly for both project areas.

Cover Type (Mid-scale)
Under Alternative 3, ponderosa pine post-treatment snags greater than 12 inches dbh meet Forest Plan standards in all cover types across the FWPP area; however, snags greater than 18 inches dbh would continue to be below standards in the ponderosa pine, mixed conifer and aspen in the DLH area and the ponderosa pine in the MM area.

For aspen, the post-treatment density of snags would remain the same immediately after treatment and 20 years post treatment. Within 40 years there would be no aspen snags remaining.

None of the cover types currently meet the Forest Plan standard for snags or logs at the mid- scale level. There may be an additional loss of snags from burning; however, burning may also create new snags. Overall the project is designed to grow trees into larger size classes providing more recruitment snags over the long term.

Site/Stand (Small Scale)
Alternative 3 would impact snags on a site/stand level due to removal for safety reasons during helicopter operations and would not meet Forest Plan standards in some stands immediately after treatment. In the long-term (approximately 20- 40 years after treatment) snags would increase as trees would in time naturally convert to snags. Recruitment snags would be identified and retained from live trees that exhibit defects ideal for wildlife. No cable logging would occur under this alternative, which would reduce the need to remove the large trees and snags on steep slopes and also the need to create corridors. The areas proposed for harvest by helicopter logging would still need to have hazard trees removed. Alternative 3 would treat approximately 972 acres with helicopter logging with most snags cut for safety purposes. Design features have been incorporated to provide for patches of snags up to 10 acres in size to serve as reserve areas within these units.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Project (Landscape) and Cover Type (Mid-scale)
On a landscape and mid-scale level, effects to snags would be similar to those discussed under Alternatives 2 and 3 in that the treatments would be the same. However Alternative 4 would treat approximately 3,136 fewer acres, having less incidental loss from implementation. Direct loss of snags would be less than the other action alternatives on a project level and in all cover types except ponderosa pine, where snag loss is slightly higher.

Site/Stand (Small Scale)
Under Alternative 4, there would be only incidental change in snag densities at the site/stand level. No cable logging or helicopter logging would occur under this alternative, which would reduce the need to remove snags on steep slopes and also the need to create corridors.

Alternative 4 would have the least impact to snags on a site/stand level.

Wildlife Cover

Hiding and thermal cover are important forest attributes for wildlife habitat. Hiding cover is defined as in the Forest Plan as, “vegetation capable of hiding 90% of a standing deer or elk from human view at a distance of 200 feet or less.” Tree trunks and foliage as well as shrubs and herbaceous vegetation offer hiding cover, as do topographic features, such as rock outcroppings and terrain breaks. Thermal cover is defined in the Forest Plan as, “a stand of coniferous trees tall enough to allow animal movement and bedding with a high degree of crown closure.” Thermal cover offers protection from heat and cold. High tree crown closure also provides hiding cover from aerial predators (Forest Plan pg. 124). Combination cover includes stands that have both hiding and thermal cover qualities.

Affected Environment

The Forest Plan requires 30 percent cover within Management Area 3 (ponderosa pine and mixed conifer on slopes less than 40 percent) and Management Area 4 (ponderosa pine and mixed conifer on slopes greater than 40 percent) in a 10K block outside the Urban Rural Influence Zone (URIZ) and Wildland Urban Interface 1U (FMAZ 1U). FWPP includes five 10K blocks: Elden, Fort Valley, Joys, Pine Grove and Wallace 10Ks. For this project, wildlife cover was analyzed on a stand by stand basis across Management Area 3 and Management Area 4 in each of the five 10K blocks. Key wildlife cover areas are steep slopes and drainages across the project. Oak is interspersed throughout the ponderosa pine and provides wildlife hiding cover. Generally the multi-storied structural character of mixed conifer provides wildlife a combination of thermal and hiding cover. Overall, existing wildlife cover percentages in all five 10K Blocks are greater than cover percentages required under Forest Plan direction.

The following evaluation criteria were used to compare environmental consequences for all alternatives:

- Amount of cover
- Type of cover (thermal, hiding, and combination)
- Location of cover

Analysis Methods

Wildlife Cover for FWPP was determined with the following information:

- Wildlife cover was documented at points along goshawk survey transects across most of the project area outside of PACs. Points were mapped at most 1000 foot intervals along transect that was at most 850 feet apart. Points were offset along neighboring transects by 500 feet. At each point, surveyors determined if there was hiding cover, thermal cover or a combination of both cover types.
- Orthophoto quadrants were overlaid with transect cover data to determine if points provided a good representation of the stand vegetative structure.
- Topographic maps were reviewed to determine if there were cover effects from topographic features and to determine if slopes are inoperable due to steep or rocky terrain.
- Field examinations were conducted to evaluate cover distribution needs and to determine whether other factors contributing to effective cover were present.

Assumptions made to determine cover remaining after treatments:

- Ponderosa pine and mixed conifer fuel reduction treatments would retain thermal and hiding cover values in 60 percent of the area. The remaining 40 percent could be in openings or groups of VSS 3 (9-12-inch dbh trees). Typically trees 9 to 12 inches in diameter are not large enough to provide thermal cover and basal area/canopy would be reduced to allow for tree growth thereby reducing wildlife hiding cover immediately after treatment. In the long-term seedlings and saplings would grow in openings and VSS 3 would develop into larger size classes with higher canopies to provide hiding and thermal cover.
- MSO PAC treatments would retain both hiding and thermal cover values in 80 percent of the area.
- Wet mixed conifer, MSO nest and recovery nest/roost treatments would retain cover values.
- Thin from below to 9 inch treatments would retain thermal cover values and remove hiding cover values.
- Grassland restoration treatments would remove hiding and thermal cover values.
- Aspen restoration treatments would remove thermal cover and maintain hiding cover.
- Northern goshawk PFA fuels reduction treatments would retain hiding and thermal cover values in 70 percent of the area.
- Goshawk nest fuels reduction treatments would maintain hiding and thermal cover.
- Burn only stands would maintain thermal and hiding cover values.
- Stands would maintain hiding cover values where steep slopes are present and provide cover effects.
- Skyline corridors would reduce hiding and thermal cover within the 12-foot wide corridor (parallel corridors for the skyline need to be placed every 100 to 140 feet).
- Openings cut for developing VSS 1 and VSS 2 would not provide thermal or hiding cover immediately after treatment, although these areas would provide hiding cover approximately 20 years after treatment when seedlings and saplings begin to grow.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Under the No Action Alternative there would be no change from existing conditions. Current conditions exceed Forest Plan direction. A surplus of thermal and hiding cover for wildlife would be maintained across the project area. However, as dense forest conditions would still occur, the high fire hazard would continue to place wildlife cover at risk with respect to stand-replacing fire.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to wildlife cover within the project and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place wildlife cover at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Horizontal and vertical diversity are both important components of cover. Alternative 2 would maintain hiding cover at least 200 feet wide around dependable waters (Schultz Tank, Pushout Tank and Weimer Spring) and within MSO protected and recovery nest/roost habitats and northern goshawk nest stands. These areas provide cover for big game species as well as attributes for resident songbirds, raptors, turkey and other wildlife. Alternative 2 would still provide cover and vertical diversity for most species and would meet Forest Plan direction.

This alternative would reduce thermal and hiding cover across in all 10K blocks except Ft. Valley 10K. There would be an additional 3 percent (196 acres) loss of a combination of thermal and hiding cover from the creation of cable corridors in Elden10K and 2 percent (45 acres) loss of a combination of thermal and hiding cover in the Pine Grove 10K.This reduction would still provide adequate cover for most species and exceed Forest Plan direction.

Cumulative Effects

The cumulative effects boundary is the project area. Roads and trails within and adjacent to cover sites provide access to recreation activities, thereby reducing effectiveness of that cover for some species due to human disturbance. The Travel Management Rule (TMR) analysis was completed for the Forest (Sept. 2011) and identified a desired road system; post-TMR projects evaluate closure/decommissioning of roads not on that identified system, and would get rid of un-needed roads. The FWPP is such a project, and the existing road system is expected to change as a result with fewer miles of road ultimately existing in order to attain a manageable and sustainable road system. With the implementation of similar adjacent projects, such as 4FRI, the road density is anticipated to continue to decrease, thereby cumulatively improving the effectiveness and quality of cover across the district.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Effects to cover would be similar to those described under Alternative 2; however no cable logging would occur under this alternative, which would reduce the need to remove the large trees and snags on steep slopes and also the need to create corridors, though this alternative would still require hazard (snag) tree removal in areas proposed for helicopter logging. Alternative 3 would provide more cover than Alternative 2 due to the lack of cable corridors.

Cumulative Effects

Cumulative effects would be the same as Alternative 2.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Effects to cover would be similar to those of Alternatives 2 and 3; however there would be less area where cover attributes were reduced. No cable logging or helicopter logging would occur under this alternative, which would reduce the need to remove large trees and snags on steep slopes and also the need to create corridors. Also approximately 3,135 fewer acres would be treated, resulting in the same continued high vegetative density in those untreated acres as in the No Action Alternative. This alternative maintains the most cover of the action alternatives in Elden and Pine Grove 10Ks, the same amount of cover in Ft. Valley and Wallace10Ks and less in Joys 10K.

Cumulative Effects

Cumulative effects are the same as Alternative 3, but to a lesser degree as fewer acres would be treated.

Management Indicator Species (MIS)

The working draft Forest-wide assessment *Management Indicator Species Status Report for the Coconino National Forest* (USDA 2013) summarizes current knowledge of population and habitat trends for species identified as MIS for the Coconino National Forest. Arizona Game and Fish Department provides annual population trend updates by Game Management Unit (GMU) for game species (i.e. elk, turkey, mule deer, and pronghorn). This information when available is used to augment the MIS report. Below are descriptions of each of the management indicator species identified for management areas (MAs) within the analysis area, and a discussion of the relationship of the effects of each project alternative on forest-level population and habitat trends for each of these species. MSO protected habitat treatments may include both mixed conifer and ponderosa pine cover types.

MIS for this project are evaluated based on management area types located within the project area. The MAs listed in the following table, with associated indicator species, and are indicated to be present within the project boundary. MIS species excluded from analysis due to lack of indicator habitats or features are listed here but not included in the analysis. These species include juniper (plain) titmouse, cinnamon teal, Lucy's warbler, yellow-breasted chat, and macroinvertebrates. These are a subset of the forest-wide management areas and management indicator species. Refer to the Forest Plan for a complete list of management areas and associated management indicator species. Table 127 describes MIS and the habitat components they are indicators for.

Determination of MIS to analyze for this project was based on MA types located within the project area. Table 127 lists the MAs present within the project area and the MIS associated with each MA, as specified in the Forest Plan.

Table 127: MAs within the FWPP with the Associated MIS

MANAGEMENT AREA (MA)	MANAGEMENT INDICATOR SPECIES	ACRES WITHIN DLH AREA ON FS LANDS	ACRES WITHIN MORMTN AREA ON FS LANDS	TOTAL ACRES WITHIN FWPP ON FS LANDS
MA 3 -Ponderosa Pine and Mixed Conifer <40% Slopes	Abert squirrel, red squirrel, Mexican spotted owl, elk, northern goshawk, pygmy nuthatch, turkey, and hairy woodpecker	2890	2619	5509
MA 4 -Ponderosa Pine and Mixed Conifer >40% Slopes	Abert squirrel, red squirrel, Mexican spotted owl, elk, northern goshawk, pygmy nuthatch, turkey, and hairy woodpecker	3389	345	3734
MA 5 - Aspen	Red-naped sapsucker, mule deer	89	2.0	91
MA 6 – Unproductive Timber Land	Elk, mule deer, Abert squirrel and hairy woodpecker	672	N/A	672
MA 8 -Pinyon-Juniper Woodland >40% Slopes	Juniper (plain) titmouse, mule deer and elk	15	N/A	15
MA 9 – Mountain Grassland	Elk, pronghorn antelope	46	N/A	46
MA10-Grassland and Sparse Pinyon-Juniper Above the Rim	Pronghorn antelope	140	N/A	140
MA 15 – Developed Recreation Site	N/A	N/A	9	9
MA18 – Elden Environmental Study Area	N/A	278	N/A	268
Electric	N/A	20	N/A	20

MANAGEMENT AREA (MA)	MANAGEMENT INDICATOR SPECIES	ACRES WITHIN DLH AREA ON FS LANDS	ACRES WITHIN MORMTN AREA ON FS LANDS	TOTAL ACRES WITHIN FWPP ON FS LANDS
PVT.	N/A	40	N/A	40

*Forest habitat acreage for MAs provided by FSVeg/RMRIS stand database. These acres may vary slightly from the Vegetation Section, which identifies acres of cover types.

Analysis Methods

The following evaluation criteria were used for MIS to compare environmental consequences for alternatives:

- Indicator Habitat Quantity
- Indicator Habitat Quality

Affected Environment for all MIS

Habitat requirements and forest-wide habitat trend as reported in USDA (2013) are summarized in Table 128 for each MIS analyzed in this report, and a summary of the findings of the forest-wide habitat trend for the species is also included. For a detailed description of the forest-wide population trend, species account, habitat requirements, and forest-wide habitat trends for each MIS, refer to USDA (2013), a copy of which is filed in the project record.

During northern goshawk surveys completed in 2013, all observations of MIS at each of the 824 call points were noted. Number of call points where MIS individuals or signs thereof were observed is reported in Table 128.

Table 128: MIS and Forestwide Population Trend, Important Habitat Components, and Forestwide Component Trends

MIS	Forest Population Trend	Indicator Habitats[1]	Habitat Component Trend	Acreage in Project Area	Forestwide Acreage (PNVT Acres)	# Call Points where Observed
Abert's Squirrel	Stable	Early seral PIPO	Increasing	6259[2]	807,424	28
Elk	Stable to Increasing	Early seral PIPO	Increasing	6259[2]	807,424	5
		Early seral MC	Increasing	0	79,060	
		Early seral S-F	Increasing	0	13,942	
Hairy woodpecker	Slightly Increasing	Snag component of PIPO	Increasing	6259[2]	807,424	19
		Snag component of MC	Inconclusive	4158	79,060	
		Snag component of S-F	Inconclusive	0	13,942	
Mexican spotted owl	Stable to Declining	Late seral MC	Increasing	4158	79,060	0
		Late seral S-F	Increasing	0	13,942	
Red-naped Sapsucker	Declining	Early seral aspen	Declining	0	3,450	0
Mule deer	Declining	Early seral aspen	Declining	0	3,450	20
		Early seral P-J	Increasing	0	601,829	

MIS	Forest Population Trend	Indicator Habitats[1]	Habitat Component Trend	Acreage in Project Area	Forestwide Acreage (PNVT Acres)	# Call Points where Observed
Northern goshawk	Stable to Declining	Late seral PIPO	Increasing	6259[2]	807,424	0
Pronghorn	Stable	Early and late seral Grassland	Stable to declining	60	266,049	0
Pygmy Nuthatch	Stable to Declining	Late seral PIPO	Declining	6259[2]	807,424	46
Red Squirrel	Stable	Late seral MC	Increasing	4158	79,060	28
		Late seral S-F	Increasing	0	13,942	
Turkey	Stable	Late seral PIPO	Increasing	6259[2]	807,424	1

Notes:
1 MC = Mixed Conifer, PIPO = Ponderosa Pine, P-J = Pinyon-Juniper, S-F = Spruce-Fir
2 Total acres of ponderosa pine in the project area

Table 129 summarizes the total acres of habitat being treated by alternative for each MIS. Table 130 summarizes the acres of habitat that would be changed for each MIS from the creation of cable corridors resulting in an indicator habitat type conversion. Table 131 summarizes the acres treated by cable or helicopter logging resulting in a loss of snags and/or large trees, changing the habitat quality for species with snags and/or late seral as an indicator habitat.

Table 129: MIS Habitat Treated by Alternative (Acres/% of Forest-wide habitat)

MIS Species	Current Forest-wide Habitat	No Action	Alt. 2	Alt.3	Alt. 4
Abert Squirrel	490,000	0	4865/0.9	4865/0.9	3846/0.7
Red Squirrel	42,000	0	3986/9.5	3986/9.0	1896/5.0
Mexican Spotted Owl	42,000	0	3986/9.5	3,986/9.0	1896/5.0
Northern Goshawk	193,812	0	4865/3.0	4865/3.0	3846/2.0
Pygmy Nuthatch	193,812	0	4865/3.0	4865/3.0	3846/2.0
Turkey	193,812	0	4865/3.0	4865/.3.0	3846/2.0
Elk	22,188	Pipo-0 MC- 0	Pipo-4865/21 MC-3986/18	Pipo-4865/21 MC-3986/18	Pipo-3846/17 MC-1896/9.0
Hairy Woodpecker	231,812	Pipo-0 MC -0	Pipo-4865/2.1 MC-3986/1.7	Pipo 4865/2.1 MC 3986/1.7	Pipo-3846/1.7 MC-1896/0.8
Red-naped Sapsucker	3,450**	0	22/0.6	22/1.0	2/.05
Mule Deer	3,450**	0	22/0.6	22/1.0	2/.05
Antelope	161,000	0	60/.04	60/.04	53/.03

** Undetermined in MIS report. Forest Plan identifies 3,450. Much of the aspen is found is the mixed conifer cover type.

Table 130: Effects to MIS indicator habitat quantity by alternative (Acres/% of Forest-wide habitat)

MIS Species	Current Forest-wide Habitat	No Action	Alt. 2	Alt.3	Alt. 4
Abert Squirrel	490,000	0	+63/+.01	-0/.0	-0/0
Red Squirrel	42,000	0	-178/-.0.4	-0/.0	-0/0
Mexican Spotted Owl	42,000	0	-178/-0.4	-0/.0	-0/0
Northern Goshawk	193,812	0	-63/-.03	-0/.0	-0/0
Pygmy Nuthatch	193,812	0	-63/-03	-0/0	-0/0

MIS Species	Current Forest-wide	No Action	Alt. 2	Alt.3	Alt. 4
Turkey	193,812	0	-63/-03	-0/.0	-0/0
Elk	22,188	Pipo 0 MC 0	Pipo+63/+0.3 MC+178/+0.3	Pipo 0/0 MC 0/0	Pipo 0/0 MC 0/0
Hairy Woodpecker	231,812	Pipo 0 MC -0	Pipo -378/-0.2 MC -912/-0.4	Pipo-296/-0.1 MC-676/-0.3	Pipo 0/0 MC 0/0
Red-naped Sapsucker	3,450*	0	0/0	0/0	0/0
Mule Deer	3,450*	0	0/0	0/0	0/0
Antelope	161,000	0	0/0	0/0	0/0

** Undetermined in MIS report. Forest Plan identifies 3,450. Much of the aspen is found is the mixed conifer cover type

Table 131: Effects to MIS habitat quality by alternative (Acres/% of Forest-wide habitat)

MIS Species	Current Forest-wide Habitat	No Action	Alt. 2	Alt.3	Alt. 4
Abert Squirrel	490,000	0	+63/+.01	0/0	-0/0
Red Squirrel	42,000	0	-912/-2.2	-676/-1.6	-0/0
Mexican Spotted Owl	42,000	0	-912/-2.2	-676/-1.6	-0/0
Northern Goshawk	193,812	0	-378/-0.2	-296/-0.2	-0/0
Pygmy Nuthatch	193,812	0	-378/-.0.2	-296/-.0.2	-0/0
Turkey	193,812	0	-378/-0.2	-296/-0.2	-0/0
Elk	22,188	Pipo 0 MC 0	Pipo+63/+.01 MC+178/+0.8	Pipo 0/0 MC 0/0	Pipo 0/0 MC 0/0
Hairy Woodpecker	231,812	Pipo 0 MC 0	Pipo-378/-0.2 MC -912/-0.4	Pipo-296/-.01 MC-676/-.01	Pipo 0/0 MC 0/0
Red-naped Sapsucker	3,450*	0	0/0	0/0	0/0
Mule Deer	3,450*	0	0/0	0/0	0/0
Antelope	161,000	0	+9/ +<.01	+9/+<.01	+9/+<.01

** Undetermined in MIS report. Forest Plan identifies 3,450. Much of the aspen is found is the mixed conifer cover type.

Abert Squirrel

Affected Environment

Population trend. The forest-wide population trend is inconclusive since there is little forest-specific data. Statewide information indicates a stable trend for hunter harvest of squirrels. Abert squirrels are currently found throughout the ponderosa pine in the project area. Abert squirrel nesting habitat includes high canopy cover with interlocking canopies, multi-storied structure, high basal area with 18 inch dbh trees distributed throughout.

Habitat trend, early seral stage ponderosa pine. Forest-wide trend is slightly increasing. Although the age class distribution is shifting slightly, the proportion of the forest in un-even-aged conditions has stayed about the same.

The project area currently exhibits good quality habitat for Abert squirrel.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on Abert squirrel forest-wide habitat or population trends. However, dense forest conditions would still occur and the high fire hazard potential would continue to place squirrel habitat at risk with respect to stand replacing fire, resulting in an indirect adverse effect. The project area would continue to be lacking in the higher basal areas made up of large trees that provide high quality nesting habitat. Foraging habitat would continue to be limited as large tree basal areas would remain lower and densities higher reducing tree growth rates and limiting cone production.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to squirrel population or habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the analysis area.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alterative 2, the best quality nesting habitat would be reduced to lower quality nesting habitat. Mid-seral stage ponderosa pine habitat would be reduced as trees grow into larger size classes. Group sizes would vary across the landscape, with groups up to 0.7 acres in size with crowns that have interlocking canopies. Trees would grow into the larger diameter class at a faster rate than under the No Action Alternative. Although mid-seral habitat quality would be reduced, this action alternative would continue to provide recruitment, nesting and foraging habitat for Abert squirrels in the project area. There would be a complete loss of indicator habitat on approximately 63 acres where cable corridors would be created. This reduction in habitat quality is too small to alter the Forest-wide habitat or population trends.

Cumulative Effects

There would be no alteration to forest-wide habitat or population trends from Alternative 2. Past fuel reduction treatments have reduced habitat quality due to lower tree densities and lack of interlocking crowns; however, MSO protected habitat and northern goshawk PFAs have similar habitat qualities as those required for higher quality Abert squirrel habitat and densities. These protected habitats are scattered across the landscape and provide habitat for squirrels. Past fuel treatments have maintained large trees across the landscape and are reducing competition between trees for water and nutrients thereby moving toward the larger VSS size classes, which are important for Abert squirrels.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to Abert squirrel habitat would be similar as Alternative 2; however there would be no cable corridors created in this alternative with no additional loss of habitat. This alternative may have a slight change to mid-seral ponderosa pine; however, this reduction in habitat quality is too small to alter the Forest-wide habitat or population trends.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Alternative 4 would treat 3,846 acres of ponderosa pine with a fuels reduction treatment. This alternative would treat the fewest acres of Abert squirrel habitat compared to the other action alternatives. This alternative may have a slight change to mid-seral ponderosa pine; however this reduction in habitat quality is too small to alter the Forest-wide habitat or population trends.

Red Squirrel

Affected Environment

Red squirrels were documented to occur in both the DLH and MM project areas. Red squirrel and their caches were documented and caches were mapped in areas surveyed for northern goshawks.

Population trend. Forest-wide population trend is assumed to be stable given the relatively stable state-wide trend in tree squirrel harvest. The Heritage rating in Arizona is S5, indicating a secure population in the state. As with the Abert's squirrel, very little population data is available for this species Forest-wide or for larger regions. The relationship of active primary caches during the fall and winter can be used to determine squirrel populations (Vahle and Patton 1983). No population estimates have been made on the Coconino National Forest.

Habitat trend, late seral mixed conifer and spruce-fir. Forest-wide trend is slightly increasing. Forest structure is moving toward more un-even-aged conditions.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on red squirrel forest-wide habitat or population trends. However, dense forest conditions would still occur and the high fire hazard potential would continue to place squirrel habitat at risk with respect to stand replacing fire, resulting in an indirect adverse effect. Foraging habitat would continue to be limited as tree basal areas would remain lower and densities higher reducing tree growth rates and limiting cone production.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to squirrel population or habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the analysis area.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, mixed conifer fuels reduction would reduce overall stand densities, which would result in greater tree vigor and increased resistance to insect and disease. With the exception of openings, treatments will increase the late-seral component of the mixed conifer. This would create better quality habitat, resulting in an indirect beneficial effect. There would be a loss of approximately 178 acres of indicator habitat from the creation of cable corridors. Areas treated with cable logging would require the removal of snags in an additional 734 acres of red squirrel indicator habitat, reducing habitat quality. Biologist would coordinate patch placement with existing red squirrel caches however; some caches would have snags removed. With the exception of cable corridors and areas harvested by cable logging, a minimum of one cache per two acres would be identified and all trees would be retained within a 26-foot radius. Additional caches would be protected outside of cable logging units to compensate for the reduced quality within the cable logged units (see Design Features). Although there would be a loss of indicator habitat with reduced quality in a small percentage of habitat, this reduction is too small to alter the forest-wide habitat or population trend for red squirrels. Treatments proposed for this project would provide protection from stand- replacing crown fires to squirrel habitat within the project area.

Changes in red squirrel occupancy would be monitored under all alternatives. Rocky Mountain Bird Observatory (RMBO) will be conducting pre-treatment monitoring the summer of 2014 and in addition to songbirds, surveyors will be collecting red squirrel occupancy data across the project area. This and subsequent post-treatment data collection of project area changes in densities can be compared to ongoing Forest-wide survey densities to help determine if changes are treatment related or at a larger scale. Another potential monitoring plan includes monitoring to establish long-term trends in populations and habitat use and the effects of forest restoration on red squirrels. A proposal from AZGFD is described in Appendix B.

Cumulative Effects

The cumulative effects boundary for red squirrel is the project area. There would be no alteration to forest-wide habitat or population trends and there would be no cumulative effect from past, present or foreseeable projects. Past fuel reduction treatments included very few acres of treatments in mixed conifer habitat. Wilderness, MSO protected habitat and northern goshawk PFAs have similar habitat qualities as those required for higher quality red squirrel habitat and densities. These protected habitats are scattered across the landscape thereby providing habitat for squirrels.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to red squirrel habitat would be similar as Alternative 2; however the distribution of snags and large trees would be more consistently random due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. There would be no loss of indicator habitat from cable corridors; however, habitat quality would be reduced on approximately 676 acres of indicator habitat proposed for helicopter logging from the removal of snags for safety. This reduction of snags could reduce potential nest structures for red squirrels and reduce the quality of cache sites. Biologist would consider caches when identifying patches of snags to be maintained reducing the potential elimination of nest sites in these areas. This reduction in habitat quality is too small to alter the forest-wide habitat or population trends.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to indicator habitat would similar to those described for Alternatives 2 and 3; however there would be no increased loss of habitat quality from snag removal as there would be no cable or helicopter logging in this alternative. This alternative treats the least acres in mixed conifer habitats. Under Alternative 4, the wet mixed conifer belt and MSO nest cores would not be treated in the Mormon Mountain area, with a total of 1,896 acres treated in mixed conifer, 2,090 acres less than Alternative 2 and 3. This reduction in treatment acres would reduce the number of caches that could be impacted by project implementation; however there would be 2,090 less acres where large trees and recruitment snags would be developed into the future reducing long term sustainable of indicator habitat.

Mexican Spotted Owl (MSO)

Affected Environment

Population trend. Overall, the forest-wide population trend is not known for certain, but may be stable to declining. A few new PACs are still being found on the Forest, and occupancy rates are up and down. The only demography study done on the Coconino National Forest indicated a declining trend, but the study did not span a sufficient time period to make long-term population trend estimates, and climatic factors are thought to play a significant role in influencing survival and reproduction of owls (Seamans 2002).

Habitat trend, late seral mixed conifer and spruce-fir. Forest-wide trend is slightly increasing. These forest types are moving toward a more even-aged structure.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on MSO forest-wide habitat or population trends. However, dense forest conditions would still occur and the high fire hazard potential would continue to place owl habitat at risk with respect to stand replacing fire, resulting in an indirect adverse effect. For additional information about impacts to MSO, see analysis in TES section above.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to MSO population or habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the analysis area.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, there are approximately 3,986 acres that are proposed for treatment in mixed conifer. Uneven-aged management would reduce overall stand densities which would result in greater tree vigor and increased resistance to insect and disease. Prescribed burns would be of low intensity. Vegetation treatments would create openings for development of VSS 1 and VSS 2 reducing late-seral habitat by 20 percent within treated areas. With the exception of cable corridors, there would not be a noticeable difference in the number of 18 inch dbh trees across the landscape. This alternative would remove late seral indicator habitat on 178 acres from the creation of cable corridors. There would be an additional reduction of habitat quality for 912 acres harvested by cable logging, where snags would be cut for safety purposes. This loss of habitat and reduction of habitat quality is too small to alter the Forest-wide habitat or population trends. Alternative 2 would provide protection from stand-replacing crown fires to remaining MSO habitat within the project area.

Cumulative Effects

There would be no effect to forest-wide habitat or population trends and there would be no cumulative effect from past, present or foreseeable projects. Past fuel reduction treatments have included very few acres of treatments in mixed conifer habitat.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to MSO habitat would similar as Alternative 2; however there would be no reduction of habitat quantity due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. Helicopter logging would require additional removal of snags for safety in 676 acres reducing habitat quality. This loss is too small to alter the Forest-wide habitat or population trend for MSO.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to indicator habitat would similar to Alternatives 2 and 3; however there would be less acres treated in mixed conifer habitats. Under Alternative 4, the wet mixed conifer belt and MSO nest cores on MM would not be treated; however treatments would occur above and below that belt, and treatments would still occur within the Schultz nest core and PAC and a portion of the Elden PAC in the DLH. Alternative 4 would treat 1,896 acres in mixed conifer, 2090 acres less than Alternatives 2 and 3. This reduction in treatment acres would reduce the area treated to develop into old growth.

Northern Goshawk

Affected Environment

Population trend. The forest-wide trend is stable to declining. Although the Forest has some information on territory occupancy and reproduction, these data are not designed to detect changes in population trend. The total number of territories has increased, and state-wide BBS data indicate a significant increase, but some indicators of occupancy and productivity appear to be declining on the Forest. Monitoring and surveys are ongoing on the forest. There are three post-fledging family areas (PFA) delineated within the FWPP.

Habitat trend. Late seral –stage ponderosa pine. The Forest-wide habitat trend for late-seral ponderosa pine is increasing slightly. Although the age class distribution of ponderosa pine is shifting slightly, the proportion of the forest in uneven-ages conditions has stayed about the same.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Indicator habitat conditions for goshawks would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect to forest-wide habitat or population trends for northern goshawk. However, dense forest conditions would still occur and the high fire potential would continue to place goshawk habitat at risk with respect to stand replacing fire, resulting in an indirect adverse effect to habitat. The desired conditions for sustaining and developing late seral ponderosa pine habitat would never be attained. For additional information about impacts to northern goshawks, see analysis in TES section above.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to goshawk population or habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the analysis area.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, the quantity and quality of late-seral (VSS 5 and 6) goshawk indicator habitat would increase, resulting in a direct beneficial effect to habitat Under Alternative 2, trees would grow into the larger diameter classes at a faster rate than compared to the No Action Alternative. This alternative would increase late-seral stage habitat and would offer higher quality nesting habitat over time due to the increase in the acres of VSS 5 and 6 stands, resulting in a direct beneficial effect to habitat. Management of old growth, MSO habitat and northern goshawk PFAs under Alternative 2 would provide habitat for the northern goshawk. This alternative is expected to have no effect to the forest-wide population trends for the northern goshawk. The increase in development in late-seral stage habitat is beneficial, but the amount of change is not enough to change forest-wide habitat or population trend.

There would be a complete loss of indicator habitat on 63 acres where cable corridors would be created. There would be an additional loss of habitat quality for 378 acres harvested by cable logging due to the removal of snags for safety purposes. This reduction in habitat quantity and quality is too small to alter the forest-wide habitat or population trends.

Cumulative Effects

There are additional indirect effects from vegetation modification activities occurring in other projects, including hazard tree removal for powerlines and highways, as well as tree removal for development of state and private lands. Generally, projects on the National Forest are designed to move toward the desired conditions for northern goshawks as identified in the Forest Plan. Cumulatively, these projects combined with the effects from Alternative 2 would have no effect to the forest-wide population or habitat trend for the northern goshawk.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to northern goshawk indicator habitat would be similar as Alternative 2; however there would be no additional loss of habitat quantity due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. Helicopter logging on 296 acres of indicator habitat would require the removal of snags for safety purposes reducing habitat quality. This reduction in habitat quality or quantity is too small to alter the Forest-wide habitat or population trends.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to northern goshawk habitat would be similar to Alternatives 3 and 4; however, there would be fewer acres treated in ponderosa pine indicator habitat. Under Alternative 4, there would be no additional loss of habitat quantity from cable corridors or reduced quality from loss of snags as no areas would be harvest by cable or helicopter logging. Alternative 4 would treat 3,846 acres in ponderosa pine, 1,019 less than Alternatives 2 and 3, reducing the acres that would develop into old growth. This alternative would not reduce habitat quality or quantity enough to change the forest-wide habitat or population trends.

Pygmy Nuthatch

Affected Environment

Population trend. The forest-wide trend is stable to declining. Globally, nationally, and for Arizona, populations are considered to be secure. Pygmy nuthatches have been observed throughout the project area.

Habitat trend; late seral stage ponderosa pine. Forest-wide, the trend is increasing slightly. Although the age class distribution is slightly shifting, the proportion of the forest in uneven-aged conditions has stayed the same. Overall, snags are thought to be increasing in the ponderosa pine and would continue to increase and densities of large snags would increase (Ganey and Vojta).

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on pygmy nuthatches. However, dense forest conditions would still occur and the high fire hazard potential would persist, resulting in an indirect adverse impact.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to pygmy nuthatch population or habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the analysis area.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, trees would grow into the larger diameter classes at a faster rate than compared to the No Action Alternative. This alternative would increase late-seral stage habitat and would offer higher quality nesting habitat over time due to the increase in the acres of VSS 5 and 6 stands, resulting in a direct beneficial effect to habitat. Management of old growth, MSO habitat and northern goshawk PFAs under Alternative 2 would provide habitat for the pygmy nuthatch.

There would be a complete loss of indicator habitat on 63 acres where cable corridors would be created. There would be an additional loss of habitat quality for 378 acres harvested by cable logging due to the removal of snags for safety purposes. This reduction in habitat quantity and quality is too small to alter the Forest-wide habitat or population trends.

Cumulative Effects

There are additional cumulative effects from vegetation modification activities occurring in other projects, including hazard tree removal for powerlines and highways, as well as tree removal for development of state and private lands. Generally, projects on the National Forest are designed to move toward the desired conditions for pygmy nuthatch. Cumulatively, these projects combined with Alternative 2 would have no effect to the forest-wide population or habitat trend for the pygmy nuthatch.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to pygmy nuthatch indicator habitat would be similar as Alternative 2; however there would be no additional loss of habitat quantity due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. Helicopter logging on 378 acres of indicator habitat would require the removal of snags for safety purposes reducing habitat quality. This loss of habitat quality would be too small to alter the forest-wide habitat or population trends.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to pygmy nuthatch habitat would be similar to Alternatives 3 and 4; however, there would be fewer acres treated in ponderosa pine indicator habitat. Under Alternative 4, there would be no additional loss of habitat quantity from cable corridors or reduced quality from loss of snags as no areas would be harvested by cable or helicopter logging. Alternative 4 would treat approximately 3,846 acres in ponderosa pine, 1,019 less than Alternatives 2 and 3, reducing the acres of indicator habitat that would be treated to develop into larger size classes. This alternative would not reduce habitat quality or quantity enough to change the forest-wide habitat or population trends.

Turkey

Affected Environment

Population trend. The forest-wide trend is increasing. The trend was variable in the early part of the Forest Plan implementation period (late ‘80s and early ‘90s), although AZGFD standard survey procedures did not provide good data due to low number of observations along survey routes. AZGFD developed a better index of turkey populations in the mid1990s. Data from 1997-2001 indicate a modestly increasing trend. For the last five years, Game Management Unit (GMU) 7 shows a relatively stable trend, with all other GMUs showing a general increasing trend for both percent of archery elk hunters seeing turkeys and the number of turkeys seen per day (USDA Forest Service 2002).

Habitat trend; late-seral ponderosa pine. The age class distribution of ponderosa pine has remained essentially the same, dominated by mid-seral stage stands, with some loss of old-growth and older trees, and some early-seral stage habitat created by wildfire. The project area provides both roosting and nesting habitat for turkey. Turkey was documented at one call point within the project area.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on turkey. However, dense forest conditions would still occur and the high fire hazard potential would persist, resulting in an indirect adverse effect. There would be no effect to the forest-wide population or habitat trend for turkey.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to turkey population or habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the analysis area.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, with the exception of cable corridors, all yellow-barked ponderosa pine trees within turkey roosting and nesting habitat would be retained while old tree longevity is improved.

Furthermore, old growth recruitment areas are identified within turkey habitat and would add to the potential numbers of turkey roost tree groups. Trees would grow into the larger diameter classes at a faster rate than compared to the No Action Alternative. Alternative 2 would offer higher quality roosting habitat over time due to the increase in VSS 5 and 6 stands.

There would be a complete loss of indicator habitat on approximately 63 acres where cable corridors would be created. There would be an additional loss of habitat quality for 379 acres harvested by cable logging due to the removal of snags for safety purposes. This reduction in habitat quantity and quality is too small to alter the forest-wide habitat or population trends.

Cumulative Effects

There are additional cumulative effects from vegetation modification activities occurring in other projects, including hazard tree removal for powerlines and highways, as well as tree removal for development of state and private lands. Generally, projects on Forest Service lands are designed to move toward the desired conditions for turkey. Cumulatively, when combining the effects from these projects with the effects from Alternative 2, there would not be an effect to the forest-wide population or habitat trend for turkey.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to turkey indicator habitat would be similar as Alternative 2; however there would be no additional loss of habitat quantity due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. Helicopter logging on 378 acres of indicator habitat would require the removal of snags for safety purposes, reducing habitat quality in those areas. This loss of habitat quality would be too small to alter the forest-wide habitat or population trends.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to turkey habitat would be similar to Alternatives 3 and 4; however, there would be fewer acres treated in ponderosa pine indicator habitat. Under Alternative 4, there would be no additional loss of habitat quantity from cable corridors or reduced quality from loss of snags as no areas would be harvest by cable or helicopter logging. Alternative 4 would treat 3,846 acres in ponderosa pine, 1,019 less than Alternatives 2 and 3, reducing the acres that would be treated to develop into larger size classes. This alternative would not reduce habitat quality or quantity enough to change the forest-wide habitat or population trends.

Elk

Affected Environment

The analysis area provides summer range for elk and is located within AZGFD GMU 7E (DLH) and 6A (MM). GMU 7 shows a generally increasing trend in elk numbers. The AZGFD Draft Elk Management Plan's (November 2013) management objective is to continue to reduce the population for the two year period covered by this plan and then stabilize the following years. For GMU 6A, the objective is to stabilize this population.

Population trend. The forest-wide trend is stable. Elk numbers on the Forest increased

in the early to mid-1990s, with a gradual decline through 2001 to roughly the 1980s level. Elk are found throughout the project area but not in high numbers.

Habitat Trend; early seral ponderosa pine. The forest-wide trend for early-seral ponderosa pine, pinyon juniper, mixed conifer and spruce-fir is increasing slightly.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. Under the No Action Alternative, there would be no direct effect on population trends for elk. However, dense forest conditions would still occur and the high fire hazard potential would persist, resulting in an indirect adverse effect on habitat. Dense forest conditions would not reduce pressure to aspen which are documented to have limited regeneration due to dense forest conditions.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to elk population and habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the analysis area.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Alternative 2 would increase the amount of early-seral stage ponderosa pine by 63 acres and increase early-seral stage mixed-conifer by 178 acres through the creation of cable corridors resulting in a direct beneficial effect on habitat. Additionally, open canopy areas in ponderosa pine and mixed conifer would increase throughout the project area, increasing foraging habitat quality and quantity for elk. This is anticipated to distribute elk foraging throughout the project area. This increase in habitat quality and quantity is too small to alter forest-wide population and habitat trends.

Cumulative Effects

Other projects across the forest were designed to move toward a more open forest structure improving indicator habitat for elk. This project would combine with other projects to increase habitat. There would be no effect to forest-wide population or habitat trends.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to elk habitat would be similar to Alternative 2; however there would be no increase in early-seral habitat due to the absence of proposed cable corridors. These changes are too small to alter the forest-wide habitat or population trends.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to elk indicator habitat would similar to Alternatives 2 and 3; however there would be fewer acres treated to increase indicator habitat. Alternative 4 would treat 3,845 acres in ponderosa pine, acres 1,020 less than Alternatives 2 and 3. This alternative would still have beneficial effects by creating openings within the ponderosa pine and thereby improving vegetative diversity, resulting in improved habitat. This alternative would have the least amount of increased indicator habitat of all the action alternatives.

Hairy Woodpecker

Affected Environment

Hairy woodpeckers are fairly common in conifer forest types within the project area.

Population trend. The forest-wide trend is stable, or slightly increasing. Minor population decreases occur on a short-term scale of 1-3 years, but are generally followed by a recovery (USDA 2002). Hairy woodpeckers were documented to occur throughout the project area.

Habitat trend; snag component of ponderosa pine, mixed conifer, and spruce fir. Ponderosa pine snags are increasing, and the large snag component is stable. Large snags remain below Forest Plan guidelines. The best information available indicates conflicting trends for mixed-conifer and spruce-fir snags, both overall and the large tree component. Regardless, snags remain below Forest Plan standards.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would have no direct effect on hairy woodpeckers. However, dense forest conditions would still occur and the high fire hazard potential would persist, resulting in indirect adverse effects.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to hairy woodpecker population and habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the analysis area.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, management of old growth, MSO habitats, northern goshawk PFAs and snags would provide habitat for the hairy woodpecker. Alternative 2 progresses stands to larger VSS classes providing for more recruitment snags over the long-term; however there may be some losses of snags immediately after treatment, which would slightly reduce habitat quantity and quality over the short-term. There would be an additional 378 acres of ponderosa pine and 912 acres of mixed conifer where a majority of snags would be lost due to the creation of cable corridors and harvesting with cable logging which requires snags to be cut for safety purposes. Design features include saving patches of snags within areas cable logged to ensure a more consistent distribution of snags. This loss of snags would not alter enough habitat to affect the forest-wide habitat or population trend for the hairy woodpecker.

Cumulative Effects

The continued development of private land would reduce habitat for these species. Removal of hazard trees for powerlines, trails and roads would reduce snags and habitat for snag- dependent species. However, these activities combined with the effects of Alternative 2 are not expected to reduce habitat quality enough to alter forest-wide population or habitat trends.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to hairy woodpecker indicator habitat would be similar to Alternative 2; however the loss of snags would be less due to the absence of proposed cable corridors, which would reduce the need to remove snags. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. Snags would be removed on 296 acres of ponderosa pine and 676 acres of mixed conifer to in areas logged by helicopter for safety purposes. Design features would reduce the impact of this safety measure by providing patches of snags up to 10 acres in size in these areas to distribute snags more consistently across the landscape.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to hairy woodpecker indicator habitats would similar to Alternatives 2 and 3; however there would be fewer acres treated in ponderosa pine and mixed conifer habitats. No cable logging or helicopter logging would occur under this alternative, which would reduce the need to remove snags on steep slopes and also the need to create corridors. Under Alternative 4, the wet mixed conifer belt and MSO nest cores would not be treated in the MM area. Alternative 4 would treat 3,846 acres in ponderosa pine and 1,896 acres in mixed conifer, 1,019 acres and 2,090 acres less than Alternatives 2 and 3, respectively.

Mule Deer

Affected Environment

Population trend. The forest-wide trend is declining. The number of deer seen per hour and the number of fawns per 100 does from 1985 through 2001 varies, but the trend is declining. In good years, fawn production has been at levels minimal to sustaining populations, but in poor precipitation and forage years, fawn production has not kept up with mortality rates.

Habitat Trend; early-seral stages of aspen.
Aspen: Forest-wide trend is declining. Some early-seral stage stands are being created through wildfire and management activities, but recruitment is limited primarily due to grazing by animals. Management activities have not been implemented to a level, or over enough area, to prevent loss of aspen patches and provide adequate aspen recruitment. There are 22 acres of aspen cover type and varying sizes and distribution of patches of aspen within the mixed conifer.

Pinyon Juniper: Forestwide, early-seral pinyon juniper is increasing slightly.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The No Action Alternative would result in continued loss of aspen habitat for mule deer, resulting in a direct adverse effect to habitat. Pine encroachment and browsing by ungulates would continue to reduce the ability of sites to develop into mature aspen stands important to mule deer. Dense forest conditions would still occur and the high fire hazard potential would persist, resulting in additional indirect adverse effects on habitat. However, this alternative would have no direct effect on forest-wide population or habitat trends.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to mule deer population or habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. The No Action Alternative would not add any additional disturbance to wildlife species or modify habitat components within the analysis area.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, aspen restoration treatments would increase early-seral aspen habitat slightly, resulting in a direct beneficial effect to habitat. Alternative 2 would treat 22 acres of late-seral aspen, less than 1 percent of forest-wide habitat. Additional acres would be treated within the mixed conifer cover type to promote aspen recruitment within the mixed conifer. Treatments would maintain late-seral aspen while improving recruitment. This alternative would contribute positively to the forest-wide habitat but would not treat enough to change the forest-wide habitat trend. Mule deer utilize a variety of habitats and this improvement in early seral-stage aspen would not change the forest-wide population trends.

Cumulative Effects

Alternative 2 would have no effect to forest-wide population or habitat trends; however there would be a slight beneficial effect to forest-wide habitat from aspen treatment. Combined with effects from past, present or reasonably foreseeable projects, no cumulative effects to population trends are anticipated. Past and current livestock and ungulate grazing and browsing has contributed to the declining habitat trend; however treatments proposed for the project area are still anticipated to have a slight beneficial effect to habitat and would combine with other projects designed to improve aspen regeneration on the Forest.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to mule deer and mule deer habitat would be similar to Alternative 2. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. No cable logging would occur under this alternative, which would reduce the need to create corridors thereby reducing the creation of openings that may help to promote aspen regeneration within the mixed conifer.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to indicator habitat would be similar to Alternatives 2 and 3; however there would be fewer acres treated in mixed conifer and aspen habitats. Under Alternative 4, the wet mixed conifer belt and MSO nest cores on MM would not be treated. Alternative 4 would treat 1,896 acres in mixed conifer across the project area. This reduction in treatment acres would reduce the number of patches of aspen that may be treated within the mixed conifer, and the aspen component could be lost overtime. This alternative treats the least amount of aspen of all the action alternatives; however, it would not result in a change in mule deer forest-wide population or habitat trends.

Red-naped (Yellow-bellied) Sapsucker

Affected Environment

Population Trend. Available population data on the Forest comes from Christmas bird count, Breeding Bird Surveys, and long-term research conducted along the Mogollon Rim. Collectively, these data indicate that red-naped sapsucker populations fluctuate overtime, but are indicate that the trend is probably declining (USDA 2013).

Habitat Trend for late seral aspen. Forest-wide trend is declining. The MIS report did not state an amount of late-seral aspen. On the Forest, mid-to late-seral stage aspen are declining, due to both natural causes and management actions to regenerate stands. Some early-seral stage stands are being created through wildfire and management activities, but recruitment is limited primarily due to grazing by animals. Management activities have not been implemented to a level, or over enough area, to prevent loss of aspen patches and provide adequate aspen recruitment. For the FWPP area, the average density of aspen snags 18 inches dbh and greater is 0.1 per acre; however snags greater than 12 inches dbh are 20 per acre. Current snag densities in aspen provide habitat for red-naped sapsuckers. The lack of recruitment for late-seral stage aspen is a concern as these snags would become logs, another important habitat component.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. The project area contains 22 acres of late seral aspen or less than one percent of forest-wide habitat. The No Action Alternative would result in continued loss of aspen habitat for sapsuckers, resulting in an indirect adverse effect to habitat. Pine encroachment and browsing by ungulates would continue to reduce the ability of sites to develop into mature aspen stands important to sapsuckers. Dense forest conditions would still occur and the high fire hazard potential would persist, resulting in additional indirect adverse effects on habitat. Late-seral aspen would be lost with no young aspen to replace it. This could potentially cause a decline in population trends forest-wide, resulting in an indirect adverse effect to population trends.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to red-naped sapsucker population and habitat trends. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place populations and habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate. Late- and early-seral aspen would continue to be lost due to conifer encroachment and ungulate grazing and browsing, resulting in a loss of forest-wide habitat and therefore a loss of forest-wide population.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Alternative 2 would treat 22 acres of late-seral aspen, or less than one percent of forest-wide habitat. Treatments would maintain healthy late-seral aspen and would treat unhealthy stands with high tree mortality to encourage recruitment. Late-seral aspen would be expected to increase over the long term. Alternative 2 would contribute positively to the forest-wide habitat trend.

Cumulative Effects

Past and current livestock and ungulate grazing and browsing has contributed to the declining habitat trend; however continued authorization of livestock grazing through the NEPA process minimizes the effects of livestock grazing on herbaceous ground cover from managed livestock use. However, some negative effects to the quality and quantity of wildlife food and cover may occur due to ungulate grazing and browsing. Alternative 2 combined with past, present and reasonably foreseeable projects are anticipated to have beneficial effect to forest-wide population and habitat trends.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to red-naped sapsucker habitat would be similar to Alternative 2; however the distribution of snags and large trees would be more consistently random due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. No cable logging would occur under this alternative, which would reduce the need to remove the large trees and logs on steep slopes and also the need to create corridors. This would reduce the number of large trees and snags cut within PACs and wet mixed conifer in the MM area.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to indicator habitat would be similar to Alternatives 2 and 3; however there would be fewer acres treated in mixed conifer and aspen habitats. Under Alternative 4, the wet mixed conifer belt and MSO nest cores on MM would not be treated; however treatments would occur above and below that belt and within the Schultz MSO nest core on DLH. Alternative 4 would treat approximately 1,896 acres in mixed conifer. This reduction in treatment acres would reduce the number of patches of aspen that may be treated within the mixed conifer and the aspen component could be lost overtime. This alternative treats the least amount of aspen of all the action alternatives; however it would not result in a change in the red-naped sapsucker forest-wide population or habitat trends.

Pronghorn Antelope

Affected Environment

Population trend. The forest-wide population trend is stable. Pronghorn population indicators have fluctuated since the late 1980s, with fawn:doe ratios showing greater fluctuation than number of pronghorn observed per hour. Within the range of fluctuations, the population appears to be relatively stable, with fawn:doe ratios increasing somewhat over approximately the last 10 years. The Dry Lake Hills project area is in GMU 7 and Mormon Mountain is in GMU 6A. Pronghorn have not been documented in either project area.

Habitat trend; early-and late-seral grasslands. Habitat trend is stable to declining. Although the total amount of grassland habitat has generally remained stable, habitat quality is stable to declining due to tree encroachment, fire suppression, long-term climatic changes, short-term drought, and ungulate grazing. Meadows and openings have been negatively affected by pine encroachment fragmenting habitat for pronghorn. There are 60 acres of grassland habitat within the project area.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions for wildlife would remain in their current condition, notwithstanding natural processes. Under the No Action Alternative, grassland restoration would not occur, and favorable habitat for pronghorn would decrease over time as conifers would continue to encroach into those grasslands, resulting in an indirect adverse impact to habitat. Dense forest conditions would still occur and the high fire hazard potential would persist, resulting in an indirect adverse impact. However, the No Action Alternative is expected to have no effect on forest-wide population trends.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to antelope population or habitat trends. The cumulative effects of the No Action Alternative would be to reduce the grassland acres within National Forest System lands, as dense forest conditions would continue to place populations and habitat at risk of habitat loss. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have a negative effect on grassland habitats.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, 60 acres of grasslands would be restored, resulting in direct beneficial effect to habitat. Grassland restoration would increase vegetative species composition and diversity and improve the distribution and diversity of vegetative ground cover. Alternative 2 would result in both an increase of habitat and an increase in habitat quality for pronghorn. However, the increase in habitat quality is too small to alter forest-wide population trends.

Cumulative Effects

Alternative 2 would have no effect to forest-wide population trends; however there would be a beneficial effect to habitat trends from grassland restoration treatments. Combined with effects from past, present or reasonably foreseeable projects, no cumulative effects to population trends are anticipated. Past and current livestock and ungulate grazing and pine encroachment has contributed to the declining habitat trend; however treatments proposed for the project area are still anticipated to have beneficial effects to habitat.

Alternative 3 & 4

Direct, Indirect & Cumulative Effects

Effects to pronghorn habitat from Alternatives 3 and 4 would be similar to Alternative 2 in that the treatments and desired conditions would be the same. Alternative 4 would treat 53 acres of grassland habitat in the DLH area, 7 acres less than Alternatives 2 and 3. This change in habitat quality is not enough to change the forest-wide habitat or population trend for pronghorn.

Migratory Birds

Affected Environment

President Clinton signed Executive Order 13186 on January 10, 2001, placing emphasis on conservation of migratory birds. This order requires that an analysis be made of the effects of Forest Service actions on Species of Concern listed by Partners in Flight and the Birds of Conservation Concern, the effects on Important Bird Areas (IBAs) identified by Partners in Flight (Latta, et al. 1999), and the effects to important overwintering areas.

Within the project area there are mixed conifer, ponderosa pine, aspen and grasslands habitat types. A portion of the MM area is within the Anderson Mesa Important Bird Area (IBA). There are no important overwintering areas within FWPP.

Species of Concern Listed by Partners in Flight and USFWS

The Arizona Partners in Flight (APIF) Plan and the Birds of Conservation Concern (BCC) lists priority species of concern. A total of 14 species have been identified as species of concern in FWPP habitats. Project effects to Mexican spotted owl, northern goshawk and red-naped sapsucker are discussed in detail under the Threatened, Endangered, Sensitive Species and MIS sections of this report. Refer to Table 132 for the additional neotropical migratory bird species addressed in this analysis.

The following table summarizes the PIF priority species and BCC, and those that are or have the potential to occur in the analysis area by habitat type and associated habitat needs. The Wildlife Specialist Report contains more detailed information about the species listed below.

Table 132: Acres of Migratory Bird Habitat within the FWPP Area

Species	Habitat	Acres of Habitat within the Project
Olive-sided Flycatcher	Mixed Conifer	DLH- 3118 MM – 1051

Species	Habitat	Acres of Habitat within the Project
Cordilleran	Ponderosa Pine	DLH – 4336 MM - 1923
Olive Warbler		
Greater Pewee		
Grace's Warbler		
Lewis' Woodpecker		
Flammulated Owl		
Purple Martin		
Swainson's Hawk	High Elevation Grassland	DLH – 60 MM – 0
Grasshopper Sparrow		
Swainson's Hawk		
Western Burrowing Owl		
Ferruginous Hawk		
Red-naped Sapsucker	Aspen	DLH – 22

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Under the No Action Alternative, there would be no changes in the project area. Habitat conditions for birds would generally remain the same, notwithstanding natural processes. The No Action Alternative would have no direct effect on migratory birds. However, dense forest conditions would continue to place forest-dwelling migratory bird habitat at risk with respect to stand-replacing fire, resulting in indirect adverse effects.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to migratory bird habitat and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place migratory bird habitat and adjacent habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have a negative effect to migratory birds. Unintentional take could occur to migratory birds if habitat is not protected. The No Action Alternative when added to past, present and reasonably foreseeable future actions would put migratory bird habitat at greater risk.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2, northern goshawk, Mexican spotted owl, ferruginous hawk, burrowing owl, and red-naped sapsucker are discussed in previous pages of this report. Proposed activities may affect these species directly through habitat modification, or indirectly through changes in prey populations.

Under this alternative, approximately 4,865 acres of ponderosa pine habitat would be treated. Of that, 2,201 acres is pine/oak. Eight species have been identified as species of concern in pine-pine/oak habitats. They are northern goshawks, Cordilleran flycatchers, olive warblers, greater pewee, Grace's warbler, Lewis's woodpecker, flammulated owl and purple martin. Species associated forest openings and edges such as the purple martin would benefit from fuels reduction treatments. Due to the creation of openings within the project, there would be a slight increase in prey availability within the project. Through vegetation modification this project would create some open habitat and reduce tree densities which favor early succession birds. However, the project area would continue to support mostly mid-succession and late-succession vegetation stages. Burning would likely have short-term beneficial effects by temporarily increasing insect abundance.

There would be 63 acres of late-seral ponderosa pine and 178 acres of mixed conifer lost from the creation of cable corridors, which require the removal of all trees and snags. Additionally, snags would be cut for safety purposes in 315 acres of ponderosa pine and 734 acres of mixed conifer proposed for cable logging. This would reduce habitat for species associated with snags such as purple martin, Lewis' woodpecker, flammulated owls and olive-sided flycatchers.

Alternative 2 would treat 3,986 acres of mixed conifer habitat. Most of the high species rich areas are associated with MSO habitat in the project, and treatments are designed to maintain habitat components important for these species as well as forest- dwelling passerine birds.

Under Alternative 2, 22 acres of aspen would be treated. Areas of aspen within the wet mixed conifer would also be treated to create small openings to promote regeneration. Species richness is associated with aspen and red-naped sapsuckers are the species of concern listed for this habitat. Aspen treatments would result in increased size class distribution, increased health, growth and vigor and would increase biodiversity within aspen stands. These treatments would move toward improving habitat not only for red-naped sapsucker but also for a multitude of passerine birds that use this habitat.

This alternative would treat 60 acres of grassland habitat. Species associated forest openings and edges such as the purple martin, Swainson's hawk, ferruginous hawk, burrowing owl and grasshopper sparrow would benefit from restoration treatments including grassland restoration.

In all habitat types, disturbances to individuals from thinning, burning and associated smoke may cause individuals to temporarily move to other areas. Individuals may be directly impacted if burning occurs during times when young are unable to relocate. The effects from smoke and fire would be isolated, of low intensity and short duration. Burning would likely have long-term beneficial effects by increasing insect abundance post-burn.

Effects from vegetation modification and burning treatments would be beneficial due to the creation of openings and more edge effect, the retention of snags and large trees in most areas, with the exception of cable corridors and areas harvested by cable or helicopter logging. MSO protected habitat and developing old growth would continue to provide habitat for species that require old growth coniferous forests such as the flammulated owl and cordilleran flycatcher.

Under the Alternative 2, unintentional take could occur. When prescribed burning occurs during the spring and early summer, there could be some take of migratory birds from smoke impacting breeding birds and potentially impacting nesting success. Unintentional take could occur if occupied snags are burned or cut for safety purposes during implementation.

Design features, such as limiting the duration and timing of operations in MSO and goshawk habitats, lining of snags and logs, lighting techniques designed to reduce the loss of snags and the marking of snag patches up to 10 acres in size in areas logged by cable have been incorporated to reduce the potential for unintentional take to occur.

Cumulative Effects

The area of analysis is the project area. Other cumulative effects that occur within the project area include recreational activities and hazard tree removal. Ongoing recreational activities may result in disturbance of migratory birds. Removal of hazard trees for powerlines, trails and roads would reduce snags and reduce habitat for snag dependent species. Present and future forest health project activities have common objectives to improve current conditions by improving soil conditions, reducing competition of trees, managing for return of the large tree components and providing snags, logs and coarse woody debris in sufficient quantity to provide for raptor species.

Under Alternative 2, treatments would provide protection from stand-replacing crown fires to high species rich habitats. The amount of impacts from vegetation treatments that would occur to migratory birds from implementation of Alternative 2 when added to past, present and reasonably foreseeable future actions is not likely to occur to an extent that there would be a measureable negative effect on migratory bird populations.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to migratory bird habitats would be similar to Alternative 2; however the distribution of snags and large trees would be more consistently random due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. Areas helicopter logged would require the removal of most snags for safety purposes. There would be 296 acres of ponderosa pine and 676 acres of mixed conifer harvested by helicopter logging resulting in a loss of snags and potential unintentional “take” of migratory birds as noted above.

Design features, such as limiting the duration and timing of operations in MSO and goshawk habitats, lining of snags and logs, lighting techniques designed to reduce the loss of snags and the marking of snag patches up to 10 acres in size in areas logged by helicopter have been incorporated to reduce the potential for unintentional take to occur.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to migratory bird habitats under this alternative would be similar to Alternative 2 and 3; however there would be fewer acres treated in pine, pine/oak and mixed conifer habitats. Alternative 4 would treat 3,846 acres ponderosa pine, 1,896 acres in mixed conifer, 53 acres in grasslands and 2 acres of aspen. This reduction in treatment acres would reduce the number of migratory birds that could be impacted by project implementation; however there would also be fewer acres of habitat improvement.

This alternative would have the least amount of disturbance to migratory birds because there would fewer acres treated and no cable corridors or harvesting by cable or helicopter logging would be required for implementation. Additionally, there would be no noise disturbance associated with helicopter logging.

Bald and Golden Eagle Protection Act

Affected Environment

All golden and bald eagles, regardless of status, are protected under the Bald and Golden Eagle Protection Act (Eagle Act). This analysis determines if take is likely to occur with implementation of the action alternatives. Take is defined as to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb." Disturb is further defined "to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available, 1) injury to an eagle, 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior, or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior" (72 Fed. Reg.31132).

The U.S. Fish and Wildlife Service (FWS) recommends using Conservation Assessment and Strategy for bald eagles in Arizona (Driscoll et. al. 2006) in conjunction with the Bald Eagle National Guidelines (USDI 2007) to protect bald eagles in Arizona. For golden eagles, the FWS has issued a report titled *Interim Golden Eagle Technical Guidance: Inventory and Monitoring Protocols; and Other Recommendations in Support of Golden Eagle Management* and Permit Issuance (Page et. al 2010).

For bald eagles, details of the existing condition can be found is this document where bald eagles are addressed as a Forest Service Sensitive species.

Golden eagles are found nesting in a wide variety of habitats from arid desert scrub to open conifer forests. No matter what habitat they choose in the state, topography features include tall cliffs or canyon in which to construct a nest and nearby large open areas to forage for prey (AGFD 2005). Most golden eagles nesting in Arizona are primarily residents, remaining within or near their home range throughout the year. In Arizona, cliff ledges are the most common nesting substrate used by golden eagles, but they would also use tall trees (esp. ponderosa pine), junipers, rock outcrops, and in rare cases, transmission towers (Glinski et.al. 1998 in AGDF 2005).

Sightings of golden eagles have been documented and winter surveys are conducted annually on the Flagstaff Ranger District adjacent to the analysis area. Bald eagle annual winter surveys also document golden eagle sightings. There is a confirmed golden eagle nest within the Action Area.

Golden eagles often nest in areas of high rabbit populations. Golden eagles are well known for subduing large prey; however most of their diet consists of ground squirrels, rabbits, and prairie dogs. The project has limited foraging habitat for golden eagles with approximately 60 acres of grassland that could provide potential habitat.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Habitat conditions would remain in their current condition, notwithstanding natural processes. Because there would be no habitat altering activities or disturbance associated with project implementation, this alternative would have no direct effect on the golden eagle. However, dense forest conditions would still occur and the high fire hazard potential would continue to place potential golden eagle nesting and foraging habitat at risk with respect to stand-replacing fire, resulting in indirect adverse effects.

Tree densities would continue to be high, slowing their growth into larger diameter classes and thereby limiting the development of larger diameter (greater than 18 inch dbh) trees important for roosting and perching. This would have an indirect adverse effect on golden eagle habitat.

Cumulative Effects

The No Action Alternative would maintain the current fire hazard to eagle habitat and adjacent forest lands. The cumulative effects of the No Action Alternative would be to increase the number of acres of National Forest System lands that are vulnerable to severe fire effects, as dense forest conditions would continue to place eagle habitat and adjacent habitat at risk of stand-replacing fire. The fire hazard would increase over time as vegetation would continue to grow and fuel would continue to accumulate, continuing to have a negative effect to golden eagle.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Direct effects would be from activities that cause disturbances (smoke, auditory or visual) to golden eagles within or adjacent to the project. Under Alternative 2, there would be no direct effects to nesting or roosting eagles as the nearest nesting eagle is over one-half mile from the project, and noise generated from these activities is not expected to be audible at the nearest nest site. The nest location occurs on a cliff face on a raised topographic feature and it is not expected that smoke would settle around the nest long enough to cause discernible effects to golden eagles because of the air movement in away from this landscape scale feature. Smoke is expected to dissipate and settle in low lying areas overnight, eliminating the potential to impact nesting eagles outside of the project.

Under Alternative 2, mechanical treatments, broadcast and pile burning and hauling of timber may cause visual or auditory disturbance to foraging golden eagles. This disturbance would be localized, of short duration and low intensity and may impact individuals but is not expected to result in “take” of golden eagles.

Indirect effects to the golden eagle include effects to eagle habitat, eagle prey species, or prey species habitat. There are no anticipated adverse effects to prey species or prey species habitat. Indirect effects to habitat would occur from treatments that modify the number of trees in a group of suitable roost trees, as eagles prefer to roost in large trees within close proximity to other large trees. However, thinning would improve old tree longevity, resulting in beneficial effects. Lining of snags would reduce potential mortality to these components from burning activities. In addition, Alternative 2 would include developing old-growth stands in 31% of the area that may be used as future nest or perching sites for golden eagles.

There would be no effect to nesting eagles; however, there may be possible short-term disturbance to potential roosting habitat with long term benefits. Short term disturbance to foraging eagles would occur during thinning and broadcast burning activities and may cause eagles to forage in nearby areas for the duration of the activity.

Cumulative Effects

Short-term impacts associated with Alternative 2 added to similar impacts from past, present, and reasonable foreseeable projects were considered. Implementation of other fuels reduction project activities could occur simultaneously; however, it is not anticipated to combine to cause a negative effect. Other cumulative effects include hazard tree removal for powerlines, communication sites and highways, which have reduced the number of snags and large trees for perching along potential winter foraging areas in the project area. However, these activities combined with this project's activities are not anticipated to "disturb" eagles to the degree identified in the Act.

Determination of Effect

This determination is based on the above analysis for golden eagles and the analysis in this document where bald eagles are addressed as a Forest Service Sensitive species. The project's activities would not lead to "take" of golden eagles or bald eagles.

Alternative 3: Proposed Action without Cable Logging

Direct, Indirect & Cumulative Effects

Effects to golden eagle habitat would be similar to Alternative 2; however the distribution of snags and large trees would be more consistently random due to the absence of proposed cable corridors. Treatments would utilize ground-based harvesting across the majority of the project area, with helicopter logging for critical areas that are too steep, rocky or inaccessible to be treated with steep-slope machinery. No cable logging would occur under this alternative, which would reduce the need to remove the large trees and logs on steep slopes and also the need to create corridors.

The use of helicopter logging would require landings where trees area processed at the landing area with a processor. There are no documented nests within the project however; a previously-used nest is located within one-half mile of the project boundary. Helicopter flights in close proximity to nesting eagles could affect breeding success. Helicopter paths would need to be reviewed to exclude flights over occupied nest locations during the golden eagle breeding season (see design features specific to Alternative 3).

Determination of Effect

The project's activities would not lead to "take" of golden eagles or bald eagles.

Alternative 4: Minimal Treatment

Direct, Indirect & Cumulative Effects

Effects to golden eagle habitat would similar to Alternatives 2 and 3 in that the described treatments in Appendix A, Table 1 and desired conditions would be the same; however there would not be as many acres treated. Treatments would utilize ground-based harvesting across the majority of the project area, and helicopters would not be used, reducing the potential for noise disturbance from overflights to nests within the action area. No cable logging would occur under this alternative, which would reduce the need to remove the large trees and logs on steep slopes and also the need to create corridors.

Determination of Effect

The project's activities would not lead to "take" of golden eagles or bald eagles.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

Amendment 1: The effect of this Forest Plan amendment would be to facilitate more flexible management based on the updated 2012 MSO Recovery Plan rather than the 1987 Coconino National Forest Plan, which still depends on language from the original 1995 MSO Recovery Plan. Two primary reasons were cited for the original listing of the Mexican spotted owl in 1993: historical alteration of its habitat as the result of timber-management practices; and, the threat of these practices continuing as evidenced in existing national forest plans. The danger of stand-replacing wildland fire was also cited as a threat at that time. Since publication of the 1995 Recovery Plan, we have acquired new information on the biology, threats, and habitat needs of the spotted owl. The primary threats to its population in the U.S. (but likely not in Mexico) have transitioned from timber harvest to an increased potential for stand-replacing wildland fire. Recent forest management now emphasizes sustainable ecological function and a return toward pre-settlement fire regimes, both of which are more compatible with maintenance of spotted owl habitat conditions than the even-aged management regime practiced at the time of listing. Conversely, southwestern forests have experienced larger and more severe wildland fires from 1995 to the present than previous to 1995. Climate variability combined with current forest conditions may also synergistically result in increased loss of habitat from fire. The intensification of natural drought cycles and the ensuing stress placed upon forested habitats could result in even larger and more severe wildland fires in owl habitat.

Within the Forest Service's Region 3, Southwest Region (including the Coconino National Forest), National Forest Plans were amended in 1996 to incorporate management recommendations presented in the 1995 Recovery Plan for the Mexican spotted owl. Since the 1995 Recovery Plan was published, our knowledge has increased. Given these changes and new information, it is now clear that managing according to the 1995 Recovery Plan does not facilitate recovery of the owl given high fire hazard. The overriding effect of this Forest Plan amendment will be to facilitate management to reduce potential for severe fire hazard in and adjacent to MSO habitat and thus it is expected to more effectively contribute to MSO recovery in the project area over the next several decades.

Amendment 2: The effects of treatments on slopes > 40 percent are analyzed for each species in the following report. This amendment would allow equipment to operate on steep slopes. The use of steep slope equipment with enclosed cabs allows for people to be protected from potential falling trees reducing the need to cut hazard trees to insure their safety. This amendment allows us to better meet the desired future conditions for wildlife.

Scenery

Methodology

This evaluation applies current National Forest Scenery Management methodology in conjunction with existing Forest Plan direction. This analysis relies on field studies and photography from the treatment area, as well as coordination with project interdisciplinary team members, and consideration of public preferences for scenery. Cumulative scenic quality was within the geographic scope of scenic attributes and landscape character in the ponderosa pine and mixed conifer forests of the Coconino National Forest.

Integration of this scenery analysis assures the FWPP is consistent with scenery-related Forest Plan direction, USFS policies, and applicable elements of USFS Visual Management and Scenery Management systems. Refer to Appendix B of the SMS Handbook #701 for a complete list of references requiring Forest Service management of scenery and aesthetics (Forest Service 2000).

The project would help achieve the desired conditions for scenery as defined in the Forest Plan: "Maintain and enhance visual resource values by including visual quality objectives in resource planning and management activities" (1987, as amended).

Visual Management System (VMS)
Currently the scenery resources of Coconino National Forest (CNF) are managed through the application of the VMS. The VMS was adopted by the Forest Service in 1974. The culmination of the VMS were Visual Quality Objectives (VQOs) prescribed in the Forest Plan for all lands within CNF. The VQO classifications range from Preservation, Retention, Partial Retention, Modification, to Maximum Modification. For a full synopsis of each VQO see *National Forest Landscape Management: Volume 2, Chapter 1, The Visual Management System* (Forest Service 1975).

The Forest Plan is currently being revised and will be transitioning to Scenery Management System (see next section). For this project, the updated SMS inventory for the CNF will be incorporated and integrated at a project scale until Forest Plan Revision is completed. This action follows existing Forest Plan direction: *"Review the VQO inventory as a part of project planning and make necessary corrections/refinements following field checking* (USDA-Forest Service 2000). It also follows Forest Service direction "*begin using the concepts and terms contained in this Handbook (Landscape Aesthetics, A Handbook for Scenery Management) as you work on new projects or initiate forest plan revisions"* (Forest Service 2000).

Scenery Management System (SMS)
The VMS process has been updated in the Scenery Management System (SMS). Handbook direction outlining the inventory and transition process from VMS to SMS may be found in Landscape Aesthetics: A Handbook for Scenery Management (Forest Service 2000). Full adoption of the SMS is to occur as each National Forest revises its Land Management Plan. For Forests not currently undergoing the LRMP revision process, or for those requiring extensive

time for revision, application of the SMS will occur at the project level. This is the case for the Coconino National Forest.

Scenic Integrity Objectives (SIOs) are used in the SMS in much the same way as VQOs are used in VMS. The Scenic Integrity or "intactness" of national forest lands is the means by which proposed alterations to the land are evaluated. Scenic Integrity is produced from the combined inventory of scenic attractiveness, viewing distance from the observer, and concern level of forest visitors. SIOs are established for the forest and can be applied at the forest, management area or treatment area (USDA-Forest Service 2000). SIOs range from Very High, meaning the landscape character is unaltered, to Very Low, meaning the landscape character is highly altered. Intermediate levels include High (landscape character appears unaltered), Moderate (landscape character is slightly altered), and Low (landscape character is moderately altered). Another basic premise of the SMS is landscape character, which gives a geographic area its visual and cultural image. It consists of a combination of physical, biological and cultural attributes that make each landscape identifiable and unique. Landscape character embodies distinct landscape attributes that exist throughout an area (Forest Service 2000). Table 133 compares the Visual Management System rankings and terminology with the Scenery Management System.

Table 133: Scenic integrity-visual quality and perception crosswalk (Forest Service 2000)

Scenic Integrity (both Existing and Objective)	Visual Quality Objective	The Forest's Scenic Integrity as people perceive it
Very High	Preservation	Unaltered; landscape character is intact
High	Retention	Appears unaltered; deviations to landscape character are not evident
Moderate	Partial Retention	Slightly altered; deviations are subordinate to landscape character being viewed
Low	Modification	Moderately altered; deviations begin to dominate the valued landscape character being viewed
Very Low	Maximum Modification	Appears heavily altered; deviations may strongly dominate the valued landscape character.
Unacceptably Low	Unacceptable Modification	Appears extremely altered; this level is only used to inventory existing scenic integrity. It is never an objective on National Forest System lands.

Analysis Process

The FWPP project is being planned as a large scale fuels reduction project with activities planned on about 8,000 acres on the Flagstaff Ranger Districts of the Coconino NF. The proposed activities and type of the project make it an appropriate candidate for SMS refinements for managing and sustaining scenic quality within an ecosystem management context.

The purpose and need of this analysis is focused on fuels reduction. SMS Appendix J (USDA-Forest Service 2007) recognizes that disturbances across the landscape can be beneficial, and even critically important to forest health and sustainability, but they can also have detrimental impacts to scenery. Appendix J approaches landscape assessments by replacing corresponding sections within *Chapter 2 – Scenic Integrity*, and refines and supplements parts of *Chapter 1 – Landscape Character, Chapter 5 – Scenery Management System Application* and the *Glossary of Landscape Aesthetics, A Handbook for Scenery Management.* The alternative method to

Handbook Chapter 2 presented here is based on the use of two indicators for evaluating scenery: Scenic Integrity and Scenic Stability.

SMS Appendix J clarifies of the definition of scenic integrity in which it becomes an indicator of visible disturbance to the valued scenery, rather than ecosystem intactness or an immeasurable blend of the two. It adds a second scenery indicator, Scenic Stability, to identify and measure the sustainability of the valued scenery. Use of this indicator ensures that the sustainability of scenery is addressed as an issue and integrated into the project.

Overview of Issues Addressed

Disturbances across the landscape can be beneficial and even critically important to forest health and sustainability and to the safety of forested communities but can also have detrimental impacts to scenery.

Two issues were identified and will be analyzed in this section. The first was identified during project scoping in 2013 relating to scenery (Forest Service), and the second is required by the Forest Plan as a measure of progress toward desired conditions for scenery.

1. What are the potential impacts to scenic resources as a result of implementation due to the highly valued viewsheds contained within the project area?

Measure: Comparison of existing scenic character to desired scenic character (descriptive). Scenic character descriptions encompass both ecological components and cultural values. Existing scenic character provides a baseline to compare the anticipated changes from the proposed action and whether this will make progress toward the desired scenic character.

Measure: Description of expected disturbance and duration of disturbance upon completion of the project (years).

2. Will progress be made toward desired scenic integrity objectives and scenic stability?

Measure: Comparison of projected progress toward scenic stability and scenic integrity (acres).

Affected Environment

Sense of Place: Mount Elden and the Dry Lake Hills are one of the dominant elements forming Flagstaff’s sense of place nestled among the volcanic field of the San Francisco Peaks. Similarly, Mormon Mountain serves as the backdrop to the community of Mormon Lake, Arizona. The mountains have been resources for humans through time providing water, forest products, forage for livestock, habitat that supports game and wildlife, and as a part of people’s lives and culture. Local residents as well as visitors from the state, region, country and internationally (Forest Service 2012) enjoy the scenic beauty of this place as noted in the National Visitor Use Monitoring Surveys. The mountains are a reminder of seasonal change, as well as viewing pleasure. The project areas are highly visible from major highways in the surrounding area including Interstate 40, US Highway 89A, and State Highway 64, and Forest Road 3 (Lake Mary Road), as well as the BNSF railroad which includes Amtrak passenger train service. Thousands of people travelling through the area view the attractive picture of the small town in the mountainous setting and the small community of Mormon Lake seating between the mountain and lake. As such, these areas a part of each community’s image and sense of place.

The FWPP's forested character and important role in for forest users and visitors is documented in the Coconino's recreation niche (Forest Service 2008):

> "The Coconino NF is a special place because of its elevation differences ranging from 2,600 to 12,633 feet supporting diverse animal life, plant life, climate, seasonal opportunities, and geology. Prehistoric and historic cultures had strong connections to this landscape which today inspires visitors and has a restorative effect."

Existing Landscape Character: The DLH portion of the project area is in the San Francisco Peaks Landscape Character Zone landscape character type. It is characterized by ponderosa pine, mixed conifer (added by author), and spruce-fir forests with inclusions of aspen adding variety to the landscape year round. Desired conditions for scenery would be to "move toward historic, pre-European settlement conditions. Forests would be characterized by uneven-aged groups of pines, widely spaced…" (Forest Service 2011).

The MM portion of the project area is in the Ponderosa Pine landscape character zone. Vegetation is composed mostly of ponderosa pine forests, with this area being part of the largest contiguous stand of ponderosa pine in the world. Some mixed conifer forests with inclusions of aspen can be found on Mormon Mountain (Forest Service 2011).

Landform: The igneous rocks of the San Francisco Mountain volcanic center are variable and complex (Holm 1988). Elden Mountain is a dacite structure with sedimentary rock outcrops that are tilted and faulted. Dry Lake Hills were uplifted during the formation of Elden Mountain. There are numerous basalt flows from Dry Lake Hills through Switzer Mesa, some are covered by dacite flows from Elden Mountain and later andesite flows. The Mormon Mountain volcanic field is in the transition between the Basin and Range and Colorado Plateau (Gust and Arculus 1986). It is composed of igneous rocks including basalt, andesite, dacite and rhyodacite. These volcanic origins result in rocky outcrops and formations as shown in Figure 74.

Figure 74: Rocky outcrops on Mt Elden. (photo courtesy of Mountain Project, taken by JJ Schlick)

The landforms have had minor modifications as forest roads, recreation facilities and trails have been built. There is also evidence in places where past vegetation manipulation has occurred such as stumps, cull logs and so on.

Structural modifications are noticeable and detract somewhat from the scenic qualities of the areas.

Waterform: Seeps, springs and stream courses are minor attributes of the landscape character. They contribute to the valued image of the landscape. There are two main drainages in the DLH-portion of the project area; Schultz Creek and Spruce Avenue Wash (see more details in Soil and Water Specialist report). These drainages are both tributary to the Rio De Flag. Schultz Creek joins the Rio De Flag just south of the Museum of Northern Arizona on State Highway 180. Spruce Avenue Wash joins Switzer Canyon Wash prior to entering the Rio De Flag just southeast of the intersection of East Butler Avenue and South 4th Street in Flagstaff, Arizona.

There are two main stream courses with headwaters in the MM portion of the project area that enter Lake Mary, Newman Canyon and an unnamed stream course (Runyon 2014). Roughly 44 percent of the project area (1300 acres) drains through Newman Canyon. Except for roughly 22 acres (less than 1 percent) of the project area that drains through Railroad Wash entering roughly the upper portion of Upper Lake Mary, surface flow from the remainder of the project area is directed through an unnamed drainage entering the upper end of Upper Lake Mary.

Vegetation: The overstory vegetation is the most dominant scenic attribute in the project area. Both DLH and MM have coniferous cover in most places. In the lower elevations, ponderosa pine is prevalent. With increased elevation or northerly aspects, the vegetation changes to mixed conifer. There are scattered clumps of aspen, Gambel oak, and juniper depending of moisture, elevation and aspect. The understory vegetation is a minor scenic attribute largely because it is overtopped by dense coniferous vegetation.

Aspen is an important visual component in the project area, both for the contrasting color, scale and texture that stands provide and for the seasonal color change that attracts viewers to the area. Gambel oak is also an important visual component. Oak trees provide a contrast in color, texture and scale. Both aspen and Gambel oak are sparsely scattered throughout the project area.

The project area's dominant scenic identity is the conifer forest with some rocky outcrops overlaying moderate to steeply sloping volcanic landforms as noted in the examples shown below. The project areas are viewed from the foreground, middleground and background

Figure 75: Almost contiguous coniferous forest common in the project areas, as shown in Dry Lake Hills.

from roads and trails. Grassland openings less than 5 acres in size are difficult to distinguish due to dense vegetation, but some do exist. Other scenery attributes include volcanic rocks and outcrops of all sizes. Seasonal changes including reliable winter snowfall accents the scenery as do wildlife sightings of birds and mammals. Research shows that such diversity of scenery attributes supports a positive viewing experience for people traveling through or recreating within the project area, and supports the quality of life for local residents and visitors (Ryan 2005).

Ecosystem Context

This section provides a link between scenery and the ecosystems in the project area. A scenic stability analysis was completed (see the Scenery Specialist Report) that identifies and measures the sustainability of the valued scenery attributes. Scenic Stability considers the condition of the valued scenery attributes identified in the scenic character description of the Flagstaff Watershed Protection Project. It evaluates whether their condition is within the historic range of variability reference conditions, the range of conditions that indicate a properly functioning ecosystem. Stability also considers stressors that can affect scenery such as wildfire and insects and disease. Stressors may not threaten scenic attributes when the forest is functioning within reference conditions, but may become detrimental when the forest functions outside of these ranges.

Vegetation and landform both offer significant opportunities for scenery. The steep slopes of the DLH and MM make them a dramatic landscape features. Rocky outcrops and formations contribute to the unique identity of the mountain, and contribute to the complexity of planning management activities that may occur there. The vegetation carpets the landscape and provides the character of the area. There are also significant risks present in these landscapes due to the density of the forest, lack of fire, high quantities of fuels and steepness of the topography.

Vegetation is the dominant scenery attribute of the FWPP project areas. Both ponderosa pine and mixed conifer are identified as dominant attributes. Several aspects of vegetation have been evaluated as related to the desired conditions noted above. Age and size class diversity and tree density are evaluated comparing historic conditions to the existing condition.

Water form as defined for scenery management refers to surface water occurrence and characteristics (Forest Service 2000). No water form related attributes will be considered because of the lack of perennial surface flow or ponding. Rather than consider stream channels as water, they will be addressed under landform. Stream channels will be considered as a minor scenery attribute related to the potential risks associated with wildfire, intensive weather conditions (that could result in flooding), and damage to large watershed landscapes.

Landform is identified as a minor scenic attribute. As noted above, stream channels were evaluated as part of the landform, and roads are evaluated as they relate to soil stability and human caused changes.

Table 134 summarizes the scenic stability analysis for the project areas. For detailed information and analysis of the scenery attributes refer to the Scenery Specialist Report, located in the project record.

Table 134: Summary of scenery stability evaluation with condition and risk ratings.

Scenery Attribute	Existing Condition	Scenic Attribute Condition	Scenic Attribute Risk
Major Scenery Attributes: Ponderosa Pine and Mixed Conifer	Ponderosa pine and mixed conifer forests within the project are generally denser and more continuous than in reference conditions and accumulations of forest litter and woody debris are much higher than would have occurred under the historic disturbance regime. Lack of fire disturbance has led to increased tree density and fuel loads that increase the potential for uncharacteristically intense wildfire and drought-related mortality. There is a high risk of insect and/or disease outbreak, which is also a function of increased tree density.	Poor	High
Major Scenery Attributes: Ponderosa Pine and Mixed	About five percent of the ponderosa pine and 35% of mixed conifer are classified in the old forest cover type (VSS 6 per table 4). The Coconino NF Management Plan (Forest Plan) direction is for a minimum of 20%	Poor	High

Scenery Attribute	Existing Condition	Scenic Attribute Condition	Scenic Attribute Risk
Conifer	allocated to old growth. Most sites currently do not fully meet the minimum criteria for ponderosa pine or mixed conifer old growth conditions as listed in the forest plan.		
Major Scenery Attributes: Ponderosa Pine and Mixed Conifer	Use of the bark beetle hazard model for southwestern ponderosa pine and draft Ips hazard model indicates approximately 8 percent of the ponderosa pine analysis area has a low bark beetle hazard rating, while 21 percent of the area has a moderate rating and the remaining 71 percent has a high hazard of beetle attack. Evaluation of the ponderosa pine dwarf mistletoe infection shows approximately 66 percent of the area is not infected or has a low infection level, with less than 20% of the trees infected.	Fair	Moderate
Major Scenery Attributes: Ponderosa Pine and Mixed Conifer	Over 65% of Dry Lake Hills and 75% of Mormon Mountain have extreme fire hazard ratings. In the Dry Lake Hills, 88% of the project is in Fire Regime I, Condition Class 3[30]. At Mormon Mountain, 88% of the area is in Fire Regime I, Condition Class 3. Approximately 51% of Dry Lake Hills and 70% of Mormon Mountain have potential for crown fire.	Poor	High
Minor Scenery Attribute: Stream Channels	The majority of soils in the MM analysis area have moderate soil erodability factors due to steep slopes.	Poor	High
	The scenery attribute condition for existing roads is strong, and they are at low risk because they receive regular maintenance as part of the designated system of roads. Scenery attribute condition for temporary roads is fair, and stressors are	Fair	Moderate

Scenery Attribute	Existing Condition	Scenic Attribute Condition	Scenic Attribute Risk
	moderate.		

The scenic stability determination finds that of the scenery attributes selected and evaluated for the existing condition, four are at high risk and two at moderate risk. This would mean that there is HIGH risk to MOST attributes and FEW are stable. For this project scenic stability is VERY LOW. Most dominant scenery attributes of the valued scenic character are seriously threatened or absent due to their conditions and ecosystem stressors, and are not likely to be sustained. The few that remain may be moderately threatened but are likely to be sustained.

Cultural Context

The project area is highly visible and viewed by large numbers of people form from important heavily used travel corridors, including Interstate 40, Highways 89 and 180, Forest Road 3 (Lake Mary Road) and secondary travel-ways through the forest. Beyond the project area, private landowners and hikers, mountain bikers, equestrians and scenic drivers view the planning areas and the surrounding landscapes from the trails and recreation sites as well as homes, backyards and porches. The landscapes they view on a daily basis are likely very important to their quality of life. Gobster (1996) contends that “in forests…people form perceptions of place based on what they see and experience from an aesthetic point of view”.

In the 2010 National Visitor Use Monitoring survey (Forest Service 2012), visitor satisfaction was measured. Over 90 percent of those surveyed indicated high satisfaction for the condition of the scenery. The importance of the surrounding forested environment and attractive scenery are also repeated themes mentioned in the Flagstaff Regional Plan 2030 (City of Flagstaff 2013The benefits of high-quality scenery are numerous despite the fact that a dollar value is seldom assigned to it, except in regard to real estate appraisals and overall tourism revenue to communities.

Desired Scenic Character

The desired scenic character (DSC) identifies the most aesthetically desirable set of valued and sustainable scenic character attributes as possible given the multiple land uses compatible with a particular landscape. Based on the purpose and need and proposed action, Table 135 provides a comparison of existing conditions, desired conditions, and desired scenic character. Progress toward the DSC is achievable through the project level activities proposed in this project in the long term. Since the activities required to move the project toward desired conditions are substantial in some areas, short term interim scenic integrity levels would be employed during implementation.

Interim scenic integrity levels acceptable during implementation would follow the Forest Plan guidance that SIO in the treatment area may drop one level during project implementation in the short term, but must meet or exceed the mapped SIO in the long term. For example, areas mapped with an SIO of high can move down to moderate in the short term, but must meet high SIO in the long term. Implementation of the FWPP project could take up to ten years to complete, short term effects could last as long as ten years following project completion. Long term effects would be eleven years and beyond.

Table 135: Comparison of existing conditions and desired scenic character.

Existing Condition	Desired Scenic Character
Lack of recurring fire has resulted in proliferation of smaller trees that have reduced or replaced openings	Scattered groups of trees with grassy openings between that provide natural contrast and species diversity. A mosaic of openings and groups of trees allows existing scenic views and attributes to be seen.
Lack of age and size class diversity and trend toward even-aged structure. In areas with uneven-aged structure there is a lack of age and size class diversity.	Uneven aged groups of trees – all age and size classes present, but distributed across the landscape in groups and clumps. Different sizes and forms create variety and pattern across the landscape that is characteristic of the ponderosa pine forest and is the dominant visual element.
Reduced tree vigor and health leading to lack of resilience to disease, intense wildfire	Forest health is improved resulting in better resilience. Scenic attributes are sustainable into the future.
Under representation of old, mature trees	Large old mature trees are a prominent component of the uneven aged forest. The form and shape of large trees and presence of a mature forest structure is critical to the landscape character of the ponderosa pine and mixed conifer forests.

Existing Condition	Desired Scenic Character
Small trees reduce or remove openings, reduce sunlight to the forest floor resulting in sparse understory vegetation and lack of stability of stream courses.	Diversity of species and healthy understory vegetation is critical to the composition and attractiveness of forest settings. Diverse forest communities include trees, shrubs, grasses and forbs native to the area. The aesthetic experience of the ponderosa pine and mixed forest increases when the species diversity includes both fine and coarse textures, patterns, scales and colors. Stream channels provide scenic diversity and are important components of the forests. They contrast with forested settings and different plant species are often present. They provide important views.
Fire regimes have shifted to lower frequency high severity surface and crown fires.	Fire evidence is reintroduced as a natural element of the scenery in an irregular mosaic of burn patches and as maintenance burning occurs, with low to moderate burn severity. Burning is essential in order to re-establish scenic stability.
Existing roads are maintained and temporary roads are used then restored maintaining the existing landscape character.	Forest roads provide important viewing platforms for scenery. Restoration of roads closed in TMR and temporary roads re-establishes native vegetation and move these places toward the characteristic landscape, and improves the scenic quality of these areas. Restoration improves the contrast between roadbeds and the naturally occurring landscape.

Scenic Integrity Objectives (SIOs)

The SIOs for the project area are illustrated in Figure 76 and Figure 77. For the FWPP project, these represent the long term goal for fuels reduction, and are incorporated in the desired conditions as proposed above. Almost all of the project areas are mapped as SIO high, and the remaining small areas are mapped as moderate.

Figure 76: Scenic Integrity Objectives for Dry Lake Hills.

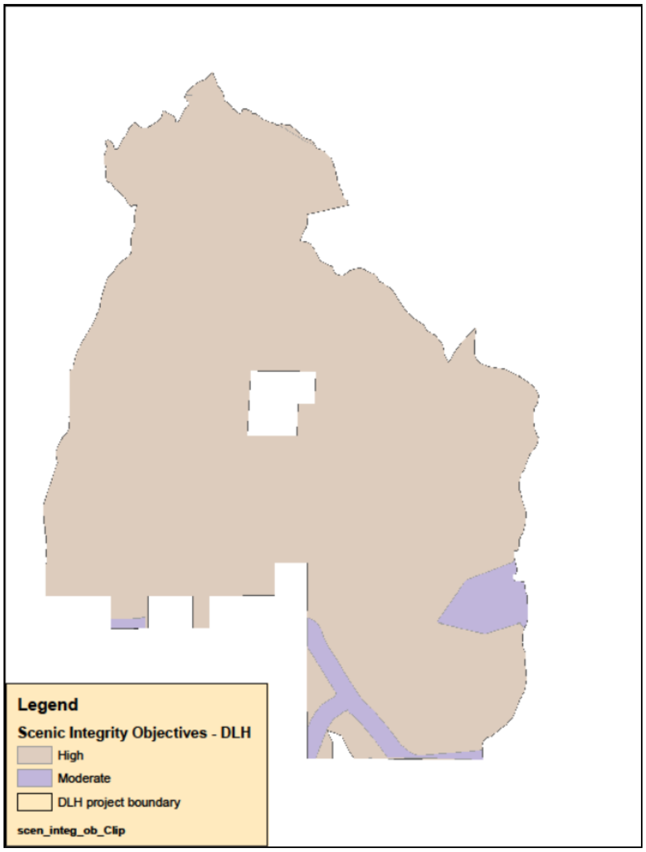
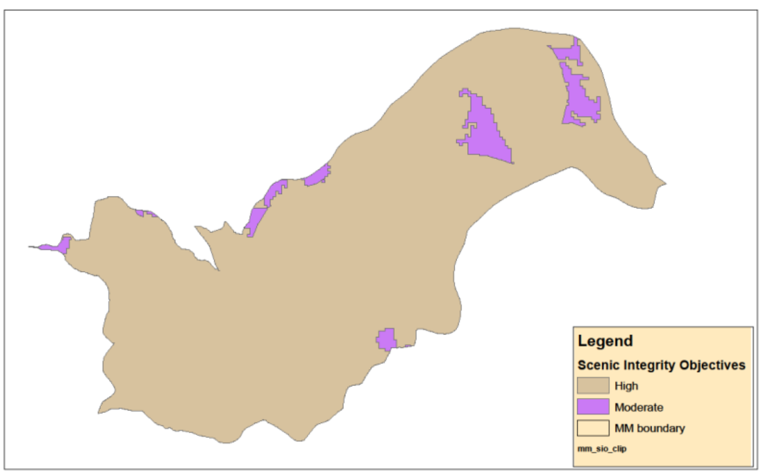


Figure 77: Scenic Integrity Objectives for Mormon Mountain.



Per the SMS Handbook (Forest Service 2000): high scenic integrity refers to landscapes where the valued landscape character "appears" intact. Deviations may be present but must repeat the form, line, color, texture and pattern common to the landscape character so completely and at such a scale that they are not evident. Moderate scenic integrity refers to landscapes where the valued landscape character "appears slightly altered." Noticeable deviations must remain visually subordinate to the landscape character being viewed.

Scenic Integrity

At the lower elevations of DLH and MM, ponderosa pine vegetation forms a dense coniferous cover. The pine trees have a somewhat spreading conical, upright form with brown to black tree boles and olive-green fine textured needles. Deciduous trees have a wider, shorter shape in contrast to the conical pine trees. Oak and aspen have moderately coarse textures and in growing seasons, a brighter green colors that is readily visible in contrast to the olive green conifers. This color contrast is even more noticeable in the fall when the deciduous tree leaves turn colors. In winter, the lighter grey bark color of the deciduous species contrasts with the brown/black of pine tree boles. Below the pine trees is a sparse understory of shrubs, grasses and forbs. The understory is mostly a low, fine textured form, although downed logs and rock outcrops provide contrast to the uniform texture. Understory colors include greens, tans, and shades of grey. In drainages there are shrubby species that add complexity in the midstory complexity of form, as well as contrasts in color, texture and pattern.

In the mixed conifer, the narrow, conical nature and varying colors of the different species is more noticeable. Less of the tree bole is visible and the tree branches extend down closer to the forest floor. There is little understory vegetation under the dense mixed conifer trees. Where openings are present, there is a grass-forb understory. In places, aspen is mixed with conifers and provides a contrast in color, texture and shape. Meadows provide welcome views as well as low, uniform and finely textured shapes.

The vegetation offers opportunities for ecosystem improvement. The current excessive vegetation density and hazardous fuels conditions are inconsistent with the DSC and scenic stability. Among the many potential scenery attributes that are under-represented are large, old trees, diverse age groups and mature forest structures (especially aspen and pines as individual trees and groups), meadows, and a diverse understory with shrubs, grasses and forbs. Many meadow areas have decreased in size and are being encroached upon by conifers, and/or are obscured from view by dense coniferous vegetation in ponderosa pine, mixed conifer types. Inter-tree spaces have mostly disappeared.

The dense conifer vegetation obscures visibility to even nearby volcanic rock forms and outcrops, and the understory is often sparse and lacks diversity. Many "view windows" outward to adjacent areas and to other noticeable landforms are obscured by vegetation. In addition, human constructed features including buildings, recreation sites, roads, and trails, as well as management activities such as logging and fire suppression have interrupted and diminished scenic vegetation attributes in most places within the project area. The sum of these occurrences has resulted in forest canopy that is excessively dense and uniform, or, fragmented in patterns and shapes inconsistent with the historic, vegetative mosaic.

Existing roads in the area also offer opportunities for ecosystem improvement. Many of the high clearance and closed roads run straight up and down slopes. Relocation of forest system roads that have overly steep sections would improve their stability. Forest roads create linear features through the landscape. These linear roads and cleared areas contrast with the characteristic landscape. They also provide viewing platforms into the project area as well as from the mountain into the surrounding landscape.

Environmental Effects

Spatial and Temporal Context for Effects Analysis

The timeframes for direct and indirect effects will include the potential for scenery disturbances up to ten years following project implementation. The analysis area for direct and indirect effects is the project area. The timeframe for cumulative effects is 20 years and the area includes the north section of the Coconino National Forest.

Alternative 1: No Action

Direct & Indirect Effects

If no actions were implemented, the project area would continue to be mostly natural-appearing for several years. Important scenery attributes such as open and diverse overstory vegetation and healthy understory would continue to have overly dense growing conditions and views into and out from the forest would be blocked by trees. The large, old tree character that historically contributed to the attractiveness of the area would be limited. Historic fire regimes would not be re-established, limiting nutrient recycling and allowing the density of forest fuels to increase. Existing steep roads closed in the Travel Management decision and those with overly steep segments would not be restored or relocated. These would continue to be used, torn up and contrast with nearby scenery. Stream channels would remain sparsely vegetated due to existing forest density. There would be no potential for a more diverse understory plant component.

At some point, overstocked vegetative conditions may be attacked by insects or disease, or experience an uncharacteristically large and intense wildfire that would burn much of the vegetation that is the dominant scenic attribute. While some insect and disease activity occurs every day, the overly dense conditions combined with extreme weather events characteristic of climate change could allow these to escalate and become wide spread. Large, high intensity fires have become more common with increasing tree density and lack of a regular fire regime. Large scale events such as these would be outside the range of historic variability. (See the Fire & Fuels and the Silviculture Specialist Reports for more details about tree density, insects and disease and fire hazard and effects.)

In the event of an uncharacteristic high severity wildfire such as the Schultz Fire, the existing landscape character would be suddenly altered with little opportunity to slow or control the change. The SIOs in the project area would have to be remapped and uncharacteristic high severity, large-scale wildfire would redefine and reshape the existing landscape character for decades if not centuries. Figure 78 shows an example of high intensity wildfire during the Radio Fire on Mt. Elden in 1977 (left) and an example of the effects on the landscape following the Schultz Fire in 2010 (right).

The appearance and character of the area would shift from green and densely forested to burnt, patchy and open. The overstory component and green canopy would be absent or drastically reduced, depending on the severity of the fire. For a at least a decade, the landscape would be dominated by blackened, dead standing trees; if allowed to come down on their own, the trees would likely fall in a dense, jack-straw pattern. Although short term, smoke from high intensity

Figure 78: Example of high intensity wildfire on Mt Elden, and effects on vegetation following Schultz Fire

wildfire would cause scenic quality to be diminished and if thick enough, would obscure views to nearby scenic attributes.

In the short term following high intensity fire, emergency fire suppression actions such as fire lines and emergency post-fire rehabilitation treatments could result in unnatural linear disturbances on the landscape. With rehabilitation and other mitigation measures, the immediate impacts of the suppression and emergency treatments should not be evident to the casual forest visitor within 2 to 3 years of completion, although effects from the fire itself would remain visible much longer. For two to three growing seasons, the blackened, exposed ground surfaces would be highly visible due to lack of vegetation. Sedimentation and erosion would increase, raveling soils that would take a long time to revegetate. Eventually these areas would be covered with spotty vegetation and invasive weeds until native material became established. Within 5 years, the effects of the fire would begin to be viewed in a somewhat more positive light as the shrubby understory became more abundant. There is some risk that a vegetation type change could occur especially if there is wide spread drought, and/or if trends toward higher temperatures, and less annual precipitation continue. There is some evidence of this potential in the Radio Fire area where ponderosa pine seedlings were planted but unsuccessful in restoring the forest. These changes would be visible throughout the project area in the foreground of Forest roads and trails, and as middle ground and background views from communities within the project area, trails, and developed recreation sites.

Initial public reaction to a large-scale fire tends to be negative, as many people do not consider extensive, blackened landscapes to be natural or beneficial (Ryan 2005). These effects are often perceived by local residents as devastating to their community and way of life; non-local forest visitors may regard the effects of a catastrophic fire as interesting and something “to be seen” but also as a degradation of the scenic quality.

Indirect effects of high intensity wildfire include short term and temporary smoke that would affect nearby subdivisions, Flagstaff, and as with large, high acreage blazes, could affect Sedona and Verde Valley, Winslow, Holbrook, Mogollon Rim communities, Grand Canyon and residents of the Navajo Nation. Effects would include smoky conditions and decreased visibility, and would last until the fire was contained and declared as “out.”

There could be wide spread flooding and sediment transport into nearby communities and neighborhoods. Other indirect effects of high intensity wildfire could include damage to the project area watersheds with subsequent effects to local reservoirs, the City of Flagstaff water system, and the scenic character of locally important recreation sites such as Mormon Lake, Upper and Lower Lakes Mary, the Rio de Flag, as well as hiking trails, driving for pleasure, scenery and wildlife viewing opportunities and others. Many times flooding and sediment transport would continue to occur for many years and even a decade after the wildfire.

Under this alternative, there would be no opportunities to enhance and improve scenic resources or achieve the desired condition since there would be no thinning or other treatments. It would maintain the existing landscape character in the short term, but in the long term the existing landscape character would decline.

Cumulative Effects

The following is list of actions relating to scenic attributes, landscape character and scenic integrity considered in the cumulative effects analysis for this project:

- Past activities that created the current conditions include grazing, the evolving forest management practices related to timber harvest and fire suppression, drought, disease and insect infestations, dispersed and developed recreation, and utility corridor clearing.
- Present and future activities such as vegetation management, fuels management, utility corridor clearing and new utility corridors, and other management activities (e.g. noxious weeds treatments). These activities could occur on private lands as well.

The cumulative effects of past management activities are visible as the existing conditions. Vegetation management practices, fire suppression, and over grazing have resulted in the current mostly even-aged forest structure, overstocked conditions, and sparse understory trees, shrubs, grasses and forbs.

The short term cumulative effects (1-5 years) of the No Action Alternative combined with similar current and future restoration treatments and prescribed burning projects are expected to be negligible, unless additional large scale, high severity wildfires occur in the ponderosa pine type. If wildfires burn large areas, the scenic quality would be decreased, and there would be long term negative changes (10 to 100 years) in scenic character. The scenic attributes that contribute to high scenic integrity, such as an open forest with tree groups of varying ages, sizes and shapes, large, mature trees, and healthy, diverse understory would not be present. The scenic impact of a high-severity wildfire would combine with scenic impacts from adjacent land development, powerline development and maintenance, and impacts from dispersed recreation use to result in a cumulative impact so that scenic integrity is greatly diminished in areas burned for up to a decade or more. In some places there would be a chance that climate change could contribute to type changes in parts of the ponderosa pine forest so that these characteristics would be replaced with difference landscape characteristics, which would also cumulatively impact scenic attributes.

In the absence of large, high severity wildfires, long term cumulative effects of the No Action alternative and present and future vegetation management and prescribed burning projects would be small and localized. In the absence of large scale treatment, the scale of treatments that are currently accomplished would not result in improvement to scenic stability or scenic integrity. The desired landscape character of an open forest with tree groups of varying sizes, shapes and ages, presence of large, mature trees, and healthy, diverse understory would not be met. This could combine with scenic effects such as scenic impacts of bare ground from grazing and recreation use and scenic effects from unhealthy forest conditions resulting from disease and drought to result in a trend toward declining landscape attributes, and less sustainable landscape character.

This alternative would not meet the project's desired conditions or Forest Plan direction. It would not move the project area toward scenic stability. Over time, scenic stability would decrease and move to no stability. No action would result in continuation of current risks to scenic attributes and it is reasonable to assume that these risks increase each year and could be exacerbated by climate change. The No Action Alternative would not meet long-term scenic integrity objectives since these are dependent upon improving the condition of scenic attributes so that they are more resilient to ecological stressors.

Irretrievable and Irreversible Commitment of Resources

This alternative does not propose changes and thus does not have any irretrievable and irreversible commitment of resources except for those associated with a high-severity wildfire, discussed above.

Effects Common to All Action Alternatives

Direct & Indirect Effects

Campfire Closure Order: The campfire closure order would have a positive effect of scenic stability throughout the DLH portion of the project area. The measure would help to reduce the potential for human-caused wild fire and subsequent detrimental effects on scenery.

Presale Activities: Numerous activities occur prior to project implementation. Trees are marked either as "leave trees" (those to be left on site, typically using orange paint), or as "cut trees" (those to be removed, typically using blue paint). Sale boundaries are also marked to delineate the edges of the project. Potential skid trails, landings, road improvements or reroutes are identified and many other activities. One noticeable activity is the boundary and tree marking.

Figure 79 provides examples of tree/boundary marking using orange (leave tree) paint. Design features provided for the project would help minimize visibility by marking the trees on the side away from roads and trails.

Figure 79: Tree and boundary marking pre-project actions would be noticeable from roads, trails and recreation sites near or within the project.

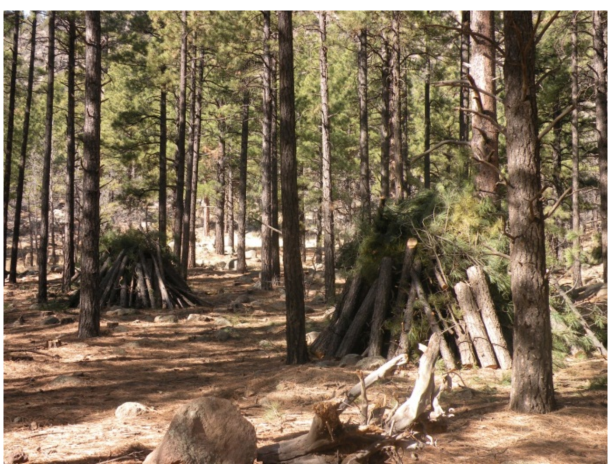
Conventional Ground Based Harvesting: Conventional logging typically has moderate short term effects to scenery. During implementation, in most cases whole trees are cut and moved to a "landing" near a haul road. At the landing, the limbs and tops are removed, and the clean logs are decked to be loaded and hauled away. After the trees have been thinned, the slash remains either to be treated in the forest or piled at landings. Effects of logging operations typically include trampling of existing vegetation where equipment is operating, creation of linear skid trails where vegetation is trampled or completely removed exposing bare soil, creation of linear log landings where vegetation has been trampled or removed and bare soil is exposed, and piles of cull logs not suitable for commercial uses. After logs or useable material is removed, most slash would be treated or if biomass removal is possible most slash would be chipped and loaded into trucks. At landings, slash piling may include bulldozers pushing slash into large piles (10-20 foot wide piles, often 10 feet tall) which can trample vegetation and cause bare soil to be exposed. For the purposes of restoring landings and skid trails, a small amount of slash may be retained to scatter and cover the bare ground. Dust from equipment would impair visibility in the immediate areas where activities are taking place. This would be short term and confined to the area around the equipment.

Chipping: Production of biomass by chipping and hauling the material off site generally results in fewer effects. It is not without effects to scenery, these would include dust and smoke from operation of equipment and additional trucks hauling material from the site. There would also be loud noise associated with chipping and blowing material into trucks that may disrupt the viewing experience. Since chipping occurs on site the duration of the noise would last longer than hand or machine piling.
Figure 80 shows an example of slash chipping.

Figure 80: Slash chipper in operation (Photo courtesy of R & S Biomass Equipment)

Hand Thin and Pile: Hand thinning usually has little or no short term effects on scenery. Trees are cut down, cut into segments and piled so that it can be treated as shown in Figure 81. Effects may include slash from limbing and topping trees. Project design features require most slash to be treated. There are about 15 acres proposed to be treated in place, effects would be similar to hand thin and pile.

Figure 81: Hand piled slash.



Machine Piling: Bulldozers push slash into large piles (10-20 foot wide piles, often 10 feet tall) which can trample vegetation and cause bare soil to be exposed as shown in Figure 82. Dust is created during piling but would be a short term effect confined to the immediate area where the equipment is working. When the piles are later burned, the heat from the fire can sterilize the ground underneath. The burned areas are susceptible to invasive weeds, and it may take several years for native vegetation to re-establish. The ground disturbance resulting from using machines to pile slash would be noticeable for three to five years after project completion, depending on how quickly the areas revegetate. Scraped trees would heal or scars would become less noticeable over time.

Figure 82: Machine piles are larger than hand piles and create more ground disturbance.

Cut to length: The cut to length system utilizes a harvester and forwarder (see Harvest Systems/Methods Descriptions in Chapter 2 for more information). Effects of the steep slope harvesting equipment would be similar to those included in ground based logging noted above.

Aspen Treatments. Aspen treatments to stimulate new sprouting require protection from ungulate browsing following treatments. A variety of treatments would be used including removal of invading conifers within 100 feet of aspen clones, prescribed fire, ripping, planting, fencing and/or cutting of aspen to stimulate root sprouting. Many aspen clones currently have dead and down and dead standing trees. Treatments are small scale and would not be very noticeable with the exception of fencing. Fencing would introduce new linear and unnatural features into the landscape. Use of the fewest contrasting materials would help to make the fencing less noticeable. Protection of sprouts is usually required for many years after treatment so that the sprouts grow large enough to withstand ungulate browsing. It is expected fencing would remain at least 10 years, and possibly longer before it could be removed. It would result in a longer term visual disturbance. It is desirable to keep aspen a part of the ecosystem if successful these treatments would result in improved scenic quality and landscape character.

Grassland Treatments. These treatments would involve removal of encroaching conifers and restoration of presettlement tree density and patterns. There would be short term negative effects, but soon after these areas would show improved scenic quality and landscape character.

Electronics Site Structure Protection. The telecommunication sites would receive thinning treatments. These are permitted facilities that provide important services to the public and they need to be protected. These locations would be thinned to 20 to 40 basal area. Thinning will open up views to the equipment and facilities in place making the contrast between the constructed facilities and surrounding landscape more obvious. At these sites, scenic integrity would only be maintain; it would not be improved.

Strategic Placement of Treatments: Strategic mechanical and fuels treatments would have relatively small effects on scenic quality immediately after treatment. Strategic fuels treatments would enhance fire control lines enabling prescribed fire to be safely implemented. They include hand thinning or use of machinery equipped with cutting or grinding heads on 300 feet either side of control lines. Slash is treated within the cleared area, and this becomes the staging area for implementing prescribed burning blocks. Effects include short term introduction of linear features throughout the area. Upon completion of prescribed burning it is expected that the linear features would not be as noticeable because the density of trees on either side of the treatment areas would be thinned and/or burned reducing the number of trees and creating a more irregular boundary.

Fuels reduction and reintroduction of fire would have moderate effects on scenic quality immediately after treatment, and low effects after repeat burning.

Pile Burning: Effects from pile burning would be primarily limited to the immediate dead and live fuels of the slash pile, although some scorching and mortality of residual trees would be expected. Following burning, the bare areas are susceptible to invasive species. Design features for invasive species would include monitoring and treating infested areas. The hand piled areas are expected to revegetate within 1 to 3 years following burning, machine piled areas are expected to revegetate within 3-5 years following burning. If areas where piles were burned are not naturally restored, it may be necessary to scratch in seed and soil from unburned areas in order to assure vegetative cover.

Prescribed Fire: Prescribed fire would be used on much of the project areas with the procedures tailored to fit the treatment types. Fire may be used in conjunction with mechanical treatments or singly. The objective of prescribed burning is to reduce fuel loading, raise crown base heights and reduce live tree density. Repeat or maintenance burning would help maintain these objectives. Repeat burning in ponderosa pine would occur every five to seven years. In mixed conifer on steep slopes, there may be only one broadcast burn because of the difficulty of implementation in these fuel types and terrain, and because the historic fire return interval is historically longer than the life of this project.

Depending on fire severity, effects would include: charred soil and vegetation immediately following burning; charred bark up to 10 feet from the ground; needle and leaf scorch typically less than 20 feet from the ground; and, loss of understory trees, trees with old scars or trees with large accumulations of dead fuels at their base. In areas of moderate to high severity, openings may be created as a result of more extensive tree mortality. The presence of charred surface vegetation and red or black trees would present a contrast to the otherwise green surroundings. These contrasts would soften and become less noticeable within two or three growing seasons after project completion as the understory component (i.e., grass, aspen and shrubs, etc.) moves in, as singed but not dead trees recover and green up, and as dead standing trees fall down. Effects may last longer and be more pronounced in areas of moderate to high fire severity, but these areas would be localized and limited. Repeat burning would temporarily blacken the forest floor, some charred bark, and scorch or burn of some understory trees and shrubs. These effects typically soften after one year, and are less noticeable to the casual observer after 2 to 3 years.

Smoke from pile burning and prescribed burning creates short term and temporary effects on scenic quality. During implementation, smoke would obscure views of the surrounding terrain and mountains. Effects to residents and visitors in the project areas may be dissatisfaction that their views are obstructed, and scenic features are obscured. Very smoky conditions typically occur during the first entry of prescribed burning due to heavy fuel loadings. There can be lingering smoke for two weeks to a month after burning as stumps, large logs and roots smolder. Smoke from repeat burns should lessen, since less fuel would be consumed.

There may be indirect effects of smoke as well since it drifts and is pushed by air currents. Nearby developed recreation sites, houses and subdivisions, and the communities may experience reduced visibility and smoky conditions. Residents may experience discomfort as a result of smoky conditions. Dispersed campers and other recreationists may experience reduced visibility and smoky conditions in some places near the project area.

Transportation System. Transportation systems used under all action alternatives would utilize a combination of existing Forest Service system roads, Forest Service system roads that are relocated to reduce erosion, previously decommissioned roads, new temporary roads and temporary roads that would be placed on existing road prisms. The approximately 4.38 miles of roads that are no longer needed for management of national forest lands would also be decommissioned under this EIS.

The Flagstaff Ranger District is concurrently conducting an environmental analysis of non-motorized recreation for trails, special uses and facilities in the Mt. Elden-Dry Lake Hills (MEDL) area. Much of MEDL planning area overlaps with the FWPP project area. There is the possibility that new temporary roads constructed under the FWPP could at a later time be converted to recreational trails. The EIS currently being prepared for FWPP will not analyze for the possible environmental effects of any future road to trail conversion within the project area. It will only analyze for the construction, use and rehabilitation of new temporary roads, not their possible conversion to a trail. If any road to trail conversion is considered under the MEDL environmental assessment, those environmental effects would be analyzed under the MEDL environmental assessment. In the FWPP project, three roads (about two miles total) would be partially relocated for use as haul routes for log trucks and eliminate overly steep grades. The unused road prisms would be restored.

Road maintenance activities would improve the condition of the existing road system, and this would be beneficial for scenery. Relocation of segments of existing roads would add new unnatural linear features into the landscape. Trees would be removed, soil exposed, and roadbeds constructed including drainage features. The old road alignments were very steep and relocation would also have beneficial effects on scenery since they would follow more natural contour lines when completed. In addition the former roadbed segments would be restored.

Construction of temporary roads would result in extensive short term effects on scenery. Effects are similar to road relocation noted above, although the temporary roads would be restored after use. Rehabilitation of temporary roads could involve several actions including but not limited to: re-contouring, scarifying the road surface, grass seeding, constructing earthen berms to prevent erosion and discourage traffic and placing slash on the road surface. Design features would be used to close entrance points and Best Management Practices for watershed would ensure drainage is re-established and the roads can rehabilitate. The temporary roads would begin to recover and should be mostly recovered and less noticeable to the casual observer in 5 to 10 years after the project is completed, and the roads are rehabilitated.

Neighborhoods near temporary roads, and forest users recreating near temporary roads may experience increased dust as a result of thinning and burning. Dust may result in hazy conditions, and may cause discomfort in the short term. Dust abatement may be used in some locations to reduce dust as a result log/biomass truck traffic

Figure 83 provides an example of an active temporary road and Figure 84 shows a temporary road 5 years after restoration. These photos are taken at different locations. Some roads may take longer to fully revegetate and others may take a shorter amount of time.

Figure 83: Active temporary road (Coconino NF).

Figure 84: A temporary road five years following rehabilitation (Coconino NF).

Road decommissioning of 4 miles of roads would entail obliteration whereby road surfaces may undergo some or all of the following actions: rip and seed or mulched with slash, inside ditches filled, road prisms outsloped, culverts and fill materials removed, stream crossings re-contoured, unstable sidecast or cutslopes removed or stabilized, and entrances blocked to prevent future access. These would have moderate short term effects to scenery. Design features would help assure these roads to a more stable status. The obliterated roads would begin to recover after treatment and would be mostly recovered and less noticeable to the casual observer in 5 to 10 years.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

In addition to effects from thinning and burning common to the action alternatives noted above, Alternative 2 proposes to use mechanical treatments on steep slopes using cable logging systems. It is important to remember that cable systems are the way the trees are transported including being gathered (yarded) and pulled together (decked). The results of the mechanical treatments are based on the prescriptions. The prescriptions provide the information about how the remaining trees would appear and the treatment objective, and whether it is proposed for restoration or fire risk reduction (refer to the Silviculturist's report tables 22 and 23 for these details (Stevenson 2014)).

Cable Logging: Cable systems are used to transport cut logs to centralized processing areas and typically have extensive, short term effects to scenery. Trees are cut and limbed, and then cables pull the trees to the landing area. Many cut trees are transported along a common corridor which can be up to 1000 feet long and are about 12 feet wide. In order to remove trees in a large area, corridors would be established about every 100 to 140 feet. Effects typically include scraping and loss of limbs on remaining trees as a result of adjacent trees being felled or transported, creation of linear corridors, slash, creation of large, cleared landings where logs are decked and equipment can be accommodated (moved and turned). Following log removal, activity slash must be treated. Methods may include bunching and piling slash mechanically which can trample vegetation and cause bare soil to be exposed, hand piling, and lopping and scattering**.**

1. What are the potential impacts to scenic resources as a result of implementation due to the highly valued viewsheds contained within the project area?

Measure: Comparison of existing scenic character to desired scenic character (descriptive). Scenic character descriptions encompass both ecological components and cultural values. Existing scenic character provides a baseline to compare the anticipated changes from the proposed action and whether this will make progress toward the desired scenic character.

The project area's dominant scenic character is the almost continuous conifer forest with some rocky outcrops overlaying moderate to steeply sloping volcanic landforms. The project areas are viewed from the foreground, middleground and background from roads and trails. Grassland openings less than 5 acres in size are difficult to distinguish due to dense vegetation, but some do exist. Other scenery attributes include volcanic rocks and outcrops of all sizes. Seasonal changes including reliable winter snowfall accents the scenery as do wildlife sightings of birds and mammals. Research shows that such diversity of scenery attributes supports a positive viewing experience for people traveling through or recreating within the project area, and supports the quality of life for local residents and visitors (Ryan 2005).

Vegetation and landform both offer significant opportunities for scenery. The steep slopes of the DLH and MM make them a dramatic landscape features. Rocky outcrops and formations contribute to the unique identity of the mountain, and contribute to the complexity of planning management activities that may occur there. The vegetation carpets the landscape and provides the character of the area. There are also significant risks present in these landscapes due to the density of the forest, lack of fire, high quantities of fuels and steepness of the topography.

Alternative 2 would treat about 85 percent of the 10,544 acre project area. The treatments involving mechanical treatments and prescribed fire would make the most progress over the next 20 years toward fuels reduction and improving the stability of the desired scenic character, and follow up burning would help to maintain gains made by the treatments. These long term gains would assure the desired scenic character is maintained for many years. Mixed conifer treatments and burning would make more short term gains in scenic character because there is no follow up burning proposed. The short term gains would make some progress toward maintaining the desired scenic character. Treatments for MSO and goshawk nest cores would show less progress toward meeting fuels reduction and desired scenic character due to specific wildlife habitat requirements. Much of the ponderosa pine and mixed conifer forest would be more resilient and would more closely resemble historic conditions. Uneven aged groups of trees of all age and size classes would be better represented. Under represented old, mature trees would be retained in most places and new trees would be recruited to help meet the deficit. It is anticipated that there would be long term improvement in understory vegetation in all areas receiving treatment, but the mechanically treated and burned areas are expected to improve the most (Noble 2011). Stream course channels would have a more diverse and healthy understory that would help protect them if wildfires do occur. The existing road system would be maintained, about 4 miles of roads would be decommissioned and all temporary roads would be rehabilitated.

In the Dry Lake Hills area, many valued viewsheds in the area would have decreased scenic quality in the short term due to the heavily altered landscape since 85% of the area would be treated in this alternative. The majority of the mechanical treatments use conventional logging, and many people are familiar with the effects associated with these (see above for descriptions of specific activities such as skidding, limbing, decking). The area will receive thinning treatments as well as pile and broadcast burning, there will be evidence of management activities from roads, trails, dispersed camps and trailheads.

While all mechanical treatments propose thinning and will result in short term disturbances of the scenery, some treatment are anticipated to have more prolonged effects. Skidding trees to landing areas creates ground disturbance on skid trails, but would not as obvious as the 12 foot wide cleared cable corridors on slopes. When people view management activities from steeper angles, they scrutinize the treatments more than those viewed at flatter angles (Forest Service 2000). Proposed cable corridors on the Schultz Pass road and the Elden Lookout road would be visible in the foreground and middleground, and could be viewed for long periods of time as forest users drive, hike, bike and ride horses by the corridors. The duration of view and viewers position make these viewsheds very sensitive and of concern to viewers (Forest Service 2000).

The Jammer cable yarding system described above would not require regularly space, cleared cable corridors. On shorter slopes (less than 300 feet) this system would provide more versatility in placement on the slope and would not require as many large and old trees be removed. There would likely be somewhat more ground disturbance since the cut trees can only be lifted as high as the boom arm allows as they are moved up slope.

Area disturbances would be most visible during and immediately after mechanical treatment concludes. As noted above, effects may include scraping and loss of limbs on “leave” trees as a result of adjacent trees being felled or transported to the cable corridor, creation of consecutive linear corridors (except where Jammer cable yarding could occur), creation of large, cleared landings where logs are decked and equipment can be accommodated (moved and turned). Following log removal, activity slash must be treated. Methods may include bunching and piling slash mechanically which can trample vegetation and cause bare soil to be exposed, hand piling, and lopping and scattering**.** When whole trees are yarded to a landing or road, large quantities of slash (branches and tree tops) will have to be bunched and piled, then treated.

The viewsheds are expected to recover as grasses and understory plants resprout and grow, scraped trees begin heal, and residual tree canopies fill in. Over time, the corridors would be less noticeable to the casual observer, and meet the scenic integrity objectives.
In the Mormon Mountain area, the topography and fewer roads and trails reduce the visibility of the proposed thinning treatments. While the landscape will be heavily altered, there are fewer acres of cable treatment proposed. In addition, the thinning and cable yarding and decking is located along temporary roads that will be restored following treatment rather than well-traveled forest roads or trails. The viewsheds are expected to recover, be less noticeable to the casual observer, and meet the scenic integrity objectives in the long term.

Measure: Description of expected disturbance and duration of disturbance upon completion of the project (years).

The short term effects common to all action alternatives have been described earlier. Jammer cable yarded areas would have slightly less recovery time than skyline or excaliner cable yarding. These provide information about expected short term effects during implementation. Project implementation may take at least ten years, but not all areas would be treated at the same time. Table 136 provides an estimate of the expected time post implementation for the desired landscape character features of the scenery to recover and improve.

Table 136: Estimated scenic recovery times by treatment type, Alternative 2

		Estimated Recovery Time Post Implementation		
Treatment Type	Acres	1-3 years	3-5 years	5-10 years
Aspen	22 hand cut/pile		X*	X*
Burn Only	270 burn only	X		
Electronic Site	18 ground based	N/A**		
Goshawk Nest Fuels Reduction	100 ground based		X	
Goshawk PFA Fuels Reduction	60 cable 299 ground based		 X	X
Grassland Restoration	60 ground based	X		
Mixed Conifer Fuels Reduction	514 cable 626 ground based		 X	X

		Estimated Recovery Time Post Implementation		
Mixed Conifer Fuels Reduction - Hand Thin	132 hand cut/pile	X		
MSO Nest Fuels Reduction - Burn Only	663 burn only	X		
MSO Nest Fuels Reduction - Hand Thin	122 hand cut/pile	X		
MSO Nest Roost Recovery - Burn Only	37 burn only	X		
MSO Nest Roost Recovery - Hand Thin	99 hand cut/pile	X		
MSO PAC Fuels Reduction	432 cable 2312 ground based 15 treat in place	 X	 X 	X
MSO PAC Fuels Reduction - Hand Thin	202 hand cut/pile	X		
MSO PAC Fuels Reduction - Wet Mixed Conifer	33 cable 147 hand cut/pile	 X		X
Ponderosa Pine Fuels Reduction	252 cable 2370 ground based		 X	X
Ponderosa Pine Fuels Reduction - Hand Thin	150 hand cut/pile	X		

*Dependent upon treatment type and if fencing is used. Fencing effects are longer lasting because trees must grow to an adequate size to withstand ungulate browsing. **Existing structure and facilities would keep the SIO at moderate.

As indicated in the table, the harvesting systems that would take the longest to recover and meet scenic integrity objectives are those prescribed for thinning and cable yarding and decking. Aspen treatments also take a long time to recover, but this is directly related to the need for long term fencing or protection in order to protect aspen sprouts from ungulate browsing. Some steep slope ground based systems may take longer to recover than more conventional (for the Flagstaff area) flat or low slope logging methods.

2. Will progress be made toward desired scenic integrity objectives and scenic stability?

Measure: Comparison of projected progress toward scenic stability and scenic integrity (acres).

The scenic integrity objective is the degree to which the landscape is free from visible disturbances that detract from the natural or socially valued appearance. As noted in the proposed Forest Plan revision, vegetation treatments should contribute toward the scenic integrity of the desired landscape character (Forest Service 2013). The scenic integrity objectives maps were presented earlier in Figure 76 and Figure 77.

Approximately 87 percent of the project area at DLH is mapped with a high scenic integrity objective, and about 73 percent of MM is mapped as high. This alternative would have the most short term negative effects to scenery due to thinning and use of the cable systems for yarding and decking in about 20 percent of the DLH area and about 3 percent of the MM area. The cable corridors created would introduce linear elements up and down the slopes in those narrow (approximately 12-foot wide) areas that are cleared of trees. The corridors could occur about every 100 to 150 feet. Corridors can be as long as 1000 feet, but the length is adjusted to fit the hillside in each location. While the cable corridors will be visible in both foreground and middleground views, the edges will be undulating because of the thinning that will create openings and groups of trees. Since cable yarding and decking has not been used locally, it is difficult to predict how quickly the areas would recover. In background views, it would be more difficult to distinguish the cable corridors since the existing patterns of vegetation and large rock outcrops already create irregular patterns in the landscape. Taking a conservative approach, in middleground views, it would be easy to distinguish the linear corridors shapes of individual trees, openings and rock outcrops. In the foreground, the corridors would be very obvious.

Jammer cable yarding would not result in the regularly spaced and cleared cable corridors. The yarding could occur on shorter slopes (less than 300 feet long), but can be articulated so that the yarding can avoid some large or old trees. Ground disturbance may be increased somewhat because logs may only be elevated to the height of the boom arm, but would not be concentrated into the same corridors.

Following are a series of photographs of actual thinning operations using skyline or excaliner cable yarding and decking. Examples from Montana and New Mexico are included. Additional examples may be found in Appendix B.

The first set of photos show examples of cable corridors from the Trapper-Bunkhouse project near Darby, Montana. The project took place decomposed granite soils. The Darby area receives an average of about 16 inches of precipitation per year (similar to Flagstaff according to the National Weather Service 2014). In the Trapper-Bunkhouse project, the forest was mostly even-aged (trees of the same age group) and the prescription was a commercial thinning where trees were evenly thinned out on a grid with a tree every 35 feet. The cable corridors were 14 feet wide. For the FWPP project, the majority prescriptions for mechanical treatments are designed to develop uneven-aged structure and a mosaic of openings and tree groups of varying sizes as noted in Table 11 of the DEIS (pp. 62-65). Cable corridor width is proposed to be 12 feet.The first photo (Figure 85) shows a corridor in mixed conifer or spruce-fir vegetation soon after harvest in a foreground view; The next figure shows cable corridors in middleground view. Figure 87 through Figure 89 show before and after photos in different seasons. It is anticipated recovery could take five to ten years and possibly longer until the tree canopies close and groundcover regrows so that the linear corridors are not as obvious. In the foreground, disturbance to the individual trees, branches and understory plants would be visible. The corridors would be more obvious.

Figure 85: A 14 foot-wide cable corridor in foreground view, Lolo National Forest

Figure 86: 14 foot-wide cable corridors in middleground view, Clearwater National Forest

Figure 87: Middleground photo before fuels reduction and cable yarding and decking begins, Bitterroot National Forest

Figure 88: One year after fuels reduction and cable yarding and decking in winter, Bitterroot National Forest

Figure 89: Two years after fuels reduction and cable yarding and decking, in summer, Bitterroot National Forest

The second set of pictures is from a fuels reduction project on the Mescalero Apache Reservation in southcentral New Mexico. The Reservation borders the Lincoln National Forest. The Tribe has been thinning ponderosa pine and mixed conifer vegetation for almost ten years starting in 2005 to the present, and using a cable system for yarding (gathering and moving trees) and decking the trees (personal communication with Sharon Paul 2014). Cable yarding was conducted at all times of the year including the summer monsoon season. Although the cabling operation did expose bare mineral soil, which was expected, gouging of soil was infrequent and instances of increased runoff resulting in accelerated erosion and transport of sediment from the corridor did not occur even though thinning operations were conducted year-round with no post-treatment mitigation measures (Paul, 2014).

Figure 90 Tree trunks are suspended as they are being yarded with cable equipment up a steep slope on the Mescalero Reservation.

Figure 91 Looking across and down a steep slope cable corridor on the Mescalero Reservation, NM.

Figure 92 Logs cable yarded to road and decked (in FWPP, logs could be hauled out or processed for biomass and hauled).

The overall scenic integrity for the entire project would be lowered during and for five to ten years following project implementation. Interim scenery goals would be used during implementation activities whereby the in high scenic integrity areas, approximately 8,203[31] acres, would drop to moderate until project completion and for 5 to 10 years following. All of the thinning acres with cable yarding and decking proposed are in high scenic integrity objective areas. Burn only, hand thin and pile would be expected to recover fastest and cable yarded areas the slowest. Approximately ten years after cable yarding and decking, vegetation recovery would move the project area toward the high scenic integrity objective. The 1,311 acres of the projects that are already moderate SIO would not require interim scenic goals. Following implementation there would be improvement in the scenic integrity of the areas with a moderate scenic integrity objective.

The scenic stability determination finds that of the scenery attributes selected and evaluated for the existing condition, four are at high risk and two are at moderate risk. This would mean that there is HIGH risk to MOST attributes and FEW are stable. For this project scenic stability is VERY LOW. Most dominant scenery attributes of the valued scenic character are seriously threatened or absent due to their conditions and ecosystem stressors, and are not likely to be sustained. The few that remain may be moderately threatened but are likely to be sustained. Assuming hand and mechanically treated areas would have piles burned and there would be follow up prescribed fire, these conclusions can be made:

Following recovery, there would be improvement in the scenic stability and scenic integrity of most areas. The main exception is the electronic sites where the existing structures and facilities will keep these areas at a moderate scenic integrity. There would be less improvement in scenic stability in MSO nest and roost areas and potentially in goshawk nest cores because specific wildlife habitat requirements. There may also be slightly less improvement in the mixed conifer areas because repeat burns are not planned. Other areas would show improved scenic stability especially with return burns. The existing road system used for hauling timber and/or biomass would be maintained and stable. Four miles of decommissioned roads would stabilized and be restored, improving scenic stability and scenic integrity. Temporary roads used for implementation would be restored. Over time this would maintain or improve scenic stability and scenic integrity.

Cumulative Effects

The actions relating to scenic attributes, landscape character and scenic integrity considered in the cumulative effects analysis for this alternative are the same as those described for the cumulative effects analysis for the No Action Alternative.

The cumulative effects of past management activities are visible as the existing conditions. Vegetation management practices, fire suppression, and over grazing have resulted in the current even-aged forest structure, overstocked conditions, sparse understory trees, shrubs, grasses and forbs, conifer encroached meadows and savannas.

The short term cumulative effects (1-5 years) of Alternative 2 combined with similar current and future forest thinning treatments and prescribed burning projects are expected to be widespread.

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[31] Project areas total acres minus no treatment

There will be evidence of treatments, and the scenic quality would be decreased in some places in most of the ponderosa pine on the Coconino and Kaibab NF. For example, in areas where treatments result in skid trails or removal of vegetation for staging areas or log decks, there could be a cumulative impact to scenic attributes where activities such as dispersed recreational use, grazing, or adjunct private land or infrastructure development is also occurring. In general these cumulative impacts to scenic attributes would be localized in scale (1-10 acres) and are most likely to be of short-term duration (1-5 years).

In the long term (5 to 20 years), there would be large and widespread improvement in the health and sustainability of scenic attributes that make up the landscape character of the ponderosa pine forest. Forest users would experience an open forest with tree groups of varying ages, sizes and shapes, large, mature trees, and healthy, diverse understory. In many places, the scenic integrity objectives would be met.

When natural stressors such as wildfires or insect outbreaks occur, or human activities such as new utility corridors, or development of a new recreation site, or a new private subdivision is developed, the cumulative effects of Alternative 2 and other projects would result in small and localized changes in the scenic character of the ponderosa pine forest. When drought conditions or unusual weather events as a result of climate change occur, the ponderosa pine forest would be healthier and more resilient to such events, thus counteracting the effects of climate change which are likely to detract from scenic attributes. The overall trend from this alternative would be toward improving landscape attributes, and sustainable landscape character.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Alternative 3 would include the effects of thinning and burning common to all alternatives and all action alternatives and would employ helicopter yarding. It is important to remember that helicopter systems are the way the trees are transported. The results of the mechanical treatments are based on the prescriptions. The prescriptions provide the information about how the remaining trees would appear, the treatment objective, and whether it is proposed for restoration or fire risk reduction (refer to the Silviculturist’s report tables 22 and 23 for these details (Stevenson 2014)).

Helicopter Yarding: Helicopter logging typically has moderate effects on scenery. Trees are typically cut and limbed leaving slash behind, but it is possible to transport whole trees. Logs would have cables attached, then would be lifted up and transported away from the cutting area to central locations (log decks) where the logs are detached from the cables. If whole trees are transported, they must be limbed at the log deck creating very large quantities of slash. Equipment such as grapplers are used at the log decks to stack logs and load them into trucks for transport. Effects include scraping and loss of limbs on existing trees as a result of adjacent trees being felled or transported, creation of large, cleared landings where slash may be piled, logs are decked and equipment can be accommodated (moved and turned) and helicopters can be landed. Following log removal, activity slash must be treated which may include bunching and piling mechanically which can trample vegetation and cause bare soil to be exposed, hand piling, and lopping and scattering. The effects of slash treatment are short term depending on how slash is treated. Hand piling creates noticeable piles, but after these are burned, there is a shorter recovery time than with mechanical piling. Lop and scatter results in untreated slash since it is allowed to remain in an area until it is burned. Ryan (2005) found this is not as acceptable as when slash is treated either by chipping or piling. Mechanical piling may include bulldozers pushing slash into large piles which can trample vegetation and cause bare soil to be exposed. When these large piles are burned the soil can be sterilized lengthening the time needed for the burned areas to rehabilitate.

1. What are the potential impacts to scenic resources as a result of implementation due to the highly valued viewsheds contained within the project area?

Measure: Comparison of existing scenic character to desired scenic character (descriptive). Scenic character descriptions encompass both ecological components and cultural values. Existing scenic character provides a baseline to compare the anticipated changes from the proposed action and whether this will make progress toward the desired scenic character.

The project area's dominant scenic character is the almost continuous conifer forest with some rocky outcrops overlaying moderate to steeply sloping volcanic landforms. The project areas are viewed from the foreground, middleground and background from roads and trails. Grassland openings less than 5 acres in size are difficult to distinguish due to dense vegetation and encroachment, but some do exist. Other scenery attributes include volcanic rocks and outcrops of all sizes. Seasonal changes including reliable winter snowfall accents the scenery as do wildlife sightings of birds and mammals. Research shows that such diversity of scenery attributes supports a positive viewing experience for people traveling through or recreating within the project area, and supports the quality of life for local residents and visitors (Ryan 2005).

Vegetation and landform both offer significant opportunities for scenery. The steep slopes of the DLH and MM make them a dramatic landscape features. Rocky outcrops and formations contribute to the unique identity of the mountain, and contribute to the complexity of planning management activities that may occur there. The vegetation carpets the landscape and provides the character of the area. There are also significant risks present in these landscapes due to the density of the forest, lack of fire, high quantities of fuels and steepness of the topography.

Alternative 3 would treat about 85 percent of the 10,544 acre project area. Many of the treatments would make progress over the next 20 years toward fuels reduction and the desired scenic character, and follow up burning in the ponderosa pine would help to maintain gains made by the treatments. Treatments for MSO and goshawk nest cores would show less progress toward meeting fuels reduction and desired scenic character due to specific wildlife habitat requirements. Much coniferous forest would be more resilient and would more closely resemble historic conditions, although lack of follow up burning in the mixed conifer vegetation will result in less progress toward the desired scenic character. Uneven aged groups of trees of all age and size classes would be better represented. Under represented old, mature trees would be retained and new trees would be recruited to help meet the deficit. Stream course channels would have a more diverse and healthy understory that would help protect them if wild fires do occur. The existing road system would be maintained, about 4 miles of roads would be decommissioned and all temporary roads would be restored. These actions would maintain or improve scenic stability and scenic integrity.

In the Dry Lake Hills and Mormon Mountain areas, many valued viewsheds would have decreased scenic quality in the short term due to the heavily altered landscape since 90% of the area would be treated in this alternative. The majority of the mechanical treatments use conventional logging, and many people are familiar with the effects associated with these (see above for descriptions of specific activities such as skidding, limbing, decking). Steep slope logging equipment will have effects similar to conventional logging, however, skid trails would be more evident because of the steeper slopes. When people view management activities from steeper angles, they scrutinize the treatments more than those viewed at flatter angles (Forest Service 2000). Skid trails would be visible on steep slopes and would be visible in the foreground and middleground. These could be viewed for several years as forest users drive, hike, bike and ride horses by the corridors. The duration of view and viewers position make these viewsheds very sensitive and of concern to viewers (Forest Service 2000).

Area disturbances would be most visible during and immediately after mechanical treatment concludes. As noted above, effects from helicopter logging include scraping and loss of limbs on existing trees as a result of adjacent trees being felled or transported, creation of large, cleared landings where slash may be piled, logs are decked and equipment can be accommodated (moved and turned) and helicopters can be landed. Figure 23 provides an example of a stand where helicopter yarding occurred on the Ashland Project and helps to illustrate the effects notes.

Figure 93 Residual slash and tree damage associated with helicopter yarding.

Photo courtesy of Jay Lininger.

Following log removal, activity slash must be treated which may include bunching and piling mechanically which can trample understory vegetation and cause bare soil to be exposed, hand piling, and lopping and scattering. The effects of slash treatment are short term depending on how slash is treated. Hand piling creates noticeable piles, but after these are burned, there is a shorter recovery time than with mechanical piling. Lop and scatter results in untreated slash since it is allowed to remain in an area until it is burned. Ryan (2005) found this is not as acceptable as when slash is treated either by chipping or piling. Mechanical piling may include bulldozers pushing slash into large piles which can trample vegetation and cause bare soil to be exposed. When these large piles are burned the soil can be sterilized lengthening the time needed for the burned areas to rehabilitate.

The viewsheds are expected to recover as grasses and understory plants resprout and grow, scraped trees begin heal, and residual tree canopies fill in. Over time, the thinned areas would be less noticeable to the casual observer, and meet the scenic integrity objectives.

Measure: Description of expected disturbance and duration of disturbance upon completion of the project.

Overall scenic integrity would be lowered for a shorter time during and for about five years following project implementation. Interim measures would be used during implementation activities whereby the in high scenic integrity areas, approximately 6,481 acres, would drop to moderate until project completion and for about 5 years following. Burn only, hand thin and pile and burn only would be expected to recover fastest and the steep slope and helicopter yarded (depending upon whether whole tree or log transit is used) areas the slowest. See Table 137 for an estimate of recovery time by treatment type. This would ensure adequate time for closed and decommissioned roads to naturalize, evidence of logging activities to recover, trailside vegetation to re-establish and initial prescribed fire activities to soften. The 1,311 acres of the projects that are already moderate SIO would not require interim measures.

Table 137: Estimated recovery time by treatment type for the Dry Lake Hills and Mormon Mountain areas, Alternative 3.

		Estimated Recovery Time Post Implementation		
Treatment Type	Acres	1-3 years	3-5 years	5-10 years
Aspen	22 hand cut/pile		X*	X*
Burn Only	270 burn only	X		
Electronic Site	18 ground based	N/A**		
Goshawk Nest Fuels Reduction	100 ground based		X	
Goshawk PFA Fuels Reduction	39 helicopter 320 ground based		X*** X	
Grassland Restoration	60 ground based	X		
Mixed Conifer Fuels	425 helicopter		X	

		Estimated Recovery Time Post Implementation		
Reduction	733 ground based		X	
Mixed Conifer Fuels Reduction - Hand Thin	85 hand cut/pile	X		
MSO Nest Fuels Reduction - Burn Only	663 burn only	X		
MSO Nest Fuels Reduction - Hand Thin	122 hand cut/pile	X		
MSO Nest Roost Recovery - Burn Only	37 burn only	X		
MSO Nest Roost Recovery - Hand Thin	99 hand cut/pile	X		
MSO PAC Fuels Reduction	267 helicopter 2520 ground based		X X	
MSO PAC Fuels Reduction - Hand Thin	202 hand cut/pile	X		
MSO PAC Fuels Reduction - Wet Mixed Conifer	766 ground based		X	
Ponderosa Pine Fuels Reduction	242 helicopter 2389 ground based		X X	
Ponderosa Pine Fuels Reduction - Hand Thin	150 hand cut/pile	X		

*Dependent upon treatment type and if fencing is used. Fencing effects are longer lasting because trees must grow to an adequate size to withstand ungulate browsing. **Existing structure and facilities would keep the SIO at moderate. ***If slash is left on site and has to be gathered into slash piles, there would be longer recovery time (closer to 5 years)

2. Will progress be made toward desired scenic integrity objectives?

Measure: Measure: Comparison of projected progress toward scenic stability and scenic integrity (acres)

The scenic stability determination finds that of the scenery attributes selected and evaluated for the existing condition, five are at high risk and one is at moderate risk. This would mean that there is HIGH risk to MOST attributes and FEW are stable. For this project scenic stability is VERY LOW. Most dominant scenery attributes of the valued scenic character are seriously threatened or absent due to their conditions and ecosystem stressors, and are not likely to be sustained. The few that remain may be moderately threatened but are likely to be sustained.

The scenic integrity or degree to which the landscape is free from visible disturbances that detracts from the natural or socially valued appearance (Forest Service 2007). The majority of both DLH and MM are shown as high scenic integrity, with small amounts of moderate. Minimum scenic integrity is achieved through activities that reduce or minimize visual disturbances in the landscape (Forest Service 2007). This project has extreme fire hazard in most of the area, and it is necessary to move the existing ecosystem conditions towards desired conditions.

This alternative would have the short term negative effects to scenery using ground based treatments and helicopter yarding. There would be fewer effects than with Alternative 2 where thinning and cable yarding and decking are proposed.

Assuming hand and mechanically treated areas would have piles burned and there would be follow up prescribed fire, these conclusions can be made:

Following recovery, there would be improvement in the scenic integrity of most areas. The main exceptions are the electronic sites where the existing structures and facilities would keep these areas at a moderate scenic integrity. There would be less improvement in scenic stability in MSO nest and roost areas and potentially in goshawk nest cores because specific wildlife habitat requirements. There may also be slightly less improvement in the mixed conifer areas because repeat burns are not planned. Other areas would show improved scenic stability especially with return burns. The existing road system used for hauling timber and/or biomass would be maintained and stable. Four miles of decommissioned roads would stabilized and be restored, improving scenic stability and scenic integrity. Temporary roads used for implementation would be restored. Over time this would maintain or improve scenic stability and scenic integrity. This alternative would result in slightly more improvement in both scenic stability and scenic integrity.

Cumulative Effects

The cumulative effects for Alternative 3 are the same as those discussed under Alternative 2.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Alternative 4 would have the same effects as those common to all action alternatives. This alternative would be similar to Alternatives 2 and 3; however the purpose of Alternative 4 is to implement the minimum amount of treatment necessary to meet the purpose and need.

1. What are the potential impacts to scenic resources as a result of implementation due to the highly valued viewsheds contained within the project area?

Measure: Comparison of existing scenic character to desired scenic character (descriptive). Scenic character descriptions encompass both ecological components and cultural values. Existing scenic character provides a baseline to compare the anticipated changes from the proposed action and whether this will make progress toward the desired scenic character.

The project area's dominant scenic character is the almost continuous conifer forest with some rocky outcrops overlaying moderate to steeply sloping volcanic landforms. The project areas are viewed from the foreground, middleground and background from roads and trails. Grassland openings less than 5 acres in size are difficult to distinguish due to dense vegetation and encroachment, but some do exist. Other scenery attributes include volcanic rocks and outcrops of all sizes. Seasonal changes including reliable winter snowfall accents the scenery as do wildlife sightings of birds and mammals. Research shows that such diversity of scenery attributes supports a positive viewing experience for people traveling through or recreating within the project area, and supports the quality of life for local residents and visitors (Ryan 2005).

Vegetation and landform both offer significant opportunities for scenery. The steep slopes of the DLH and MM make them a dramatic landscape features. Rocky outcrops and formations contribute to the unique identity of the mountain, and contribute to the complexity of planning management activities that may occur there. The vegetation carpets the landscape and provides the character of the area. There are also significant risks present in these landscapes due to the density of the forest, lack of fire, high quantities of fuels and steepness of the topography.

Alternative 4 would treat about 55 percent of the 10,544 acre project area. The areas treated would make the least progress over the next 20 years toward fuels reduction and the desired scenic character, and follow up burning would help to maintain gains made by the treatments. Treatments for MSO and goshawk nest cores would show less progress toward meeting fuels reduction and desired scenic character due to specific wildlife habitat requirements. About 62 percent of the coniferous forest would be more resilient and would more closely resemble historic conditions, although lack of repeat burning in mixed conifer forests would make less progress toward scenic stability. In these places uneven aged groups of trees of all age and size classes would be better represented. Under represented old, mature trees would be retained and new trees would be recruited to help meet the deficit. Stream course channels in treated areas would have a more diverse and healthy understory that would help protects them if wildfires do occur.

Approximately 5,800 acres would not be treated (includes about 1,600 acres in the Orion Timber Sale that would not receive additional treatment and the no treatment areas of rock and the pipeline). The remaining almost 4,200 acres not proposed for treatment would stay in the existing condition.

The existing road system would be maintained, about 4 miles of roads would be decommissioned, and all temporary roads would be restored. These actions for roads would maintain or improve scenic stability and scenic integrity.

Measure: Description of expected disturbance and duration of disturbance upon completion of the project.

Although this alternative would make the least progress toward the purpose and need, there would be less disturbance and fewer short term negative effects with this alternative than with either Alternatives 2 or 3. Table 138 shows the estimated time needed post implementation.

Table 138: Estimate of recovery time following implementation, Alternative 4.

		Estimated Recovery Time Post Implementation		
Treatment Type	Acres	1-3 years	3-5 years	5-10 years
Aspen	2 hand cut/pile		X*	X*
Burn Only	67 burn only	X		
Electronic Site	18 ground based	N/A**		
Goshawk Nest Fuels Reduction	100 ground based		X	
Goshawk PFA Fuels Reduction	286 ground based		X	
Grassland Restoration	53 ground based	X		
Mixed Conifer Fuels Reduction	542 ground based		X	
Mixed Conifer Fuels Reduction - Hand Thin	0 hand cut/pile			
MSO Nest Fuels Reduction - Burn Only				
MSO Nest Fuels Reduction - Hand Thin	122 hand cut/pile	X		
MSO Nest Roost Recovery - Burn Only	0 burn only			
MSO Nest Roost Recovery - Hand Thin				
MSO PAC Fuels Reduction	2160 ground based		X	
MSO PAC Fuels Reduction - Hand Thin	228 hand cut/pile	X		
MSO PAC Fuels Reduction - Wet Mixed Conifer	766 ground based		X	
Ponderosa Pine Fuels Reduction	2166 ground based		X	

		Estimated Recovery Time Post Implementation		
Ponderosa Pine Fuels Reduction - Hand Thin	86 hand cut/pile	X		

2. Will progress be made toward desired scenic integrity objectives?

Measure: Comparison of projected progress toward scenic stability and scenic integrity (acres)

The scenic stability determination finds that of the scenery attributes selected and evaluated for the existing condition, five are at high risk and one is at moderate risk. This would mean that there is HIGH risk to MOST attributes and FEW are stable. For this project scenic stability is VERY LOW. Most dominant scenery attributes of the valued scenic character are seriously threatened or absent due to their conditions and ecosystem stressors, and are not likely to be sustained. The few that remain may be moderately threatened but are likely to be sustained.

The scenic integrity or degree to which the landscape is free from visible disturbances that detracts from the natural or socially valued appearance (Forest Service 2000). The majority of both DLH and MM are shown as high scenic integrity, with small amounts of moderate. Minimum scenic integrity is achieved through activities that reduce or minimize visual disturbances in the landscape (Forest Service 2000). This project has extreme fire hazard in most of the area, and it is necessary to move the existing ecosystem conditions towards desired conditions.

This alternative would make the least progress toward scenic stability, but would have the least short term negative effects to scenery using ground based treatments. There would be fewer effects than with Alternative 2 where thinning and cable yarding and decking are proposed or 3 where helicopter yarding would be used.

Overall scenic integrity would be lowered for about the same over durations, but implementation would take less time. Interim measures would be used during implementation activities whereby the in high scenic integrity areas, approximately 5677[32] acres, would drop to moderate until project completion and for about 5 years following. Hand thin and pile and burn only would be expected to recover fastest and the steep slope and ground based conventional logged areas the slowest. See Table 138 for an estimate of recovery time by treatment type. This would ensure adequate time for closed and decommissioned roads to naturalize, evidence of logging activities to recover, trailside vegetation to re-establish and initial prescribed fire activities to soften. The about 670 acres of the projects that are already moderate SIO would not require interim measures.

Assuming hand and mechanically treated areas would have piles burned and there would be follow up prescribed fire, these conclusions can be made:

[32] Project areas total acres minus no treatment

Following recovery, there would be improvement in the scenic integrity in about 62 percent of the area. The remaining area would remain at existing conditions. The main exceptions are the electronic sites where the existing structures and facilities would keep these areas at a moderate scenic integrity. There would be no improvement in scenic stability in MSO nest and roost areas and less improvement in goshawk nest cores because specific wildlife habitat requirements. There may also be about half the improvement in the mixed conifer areas in addition to these areas not receiving repeat burns. Other areas would show improved scenic stability especially with return burns.

The main difference in this alternative is that the scenic stability, already very low would only be improved in about 62 percent of the area. The remaining almost 4,200 acres would show no improvement at all.

Scenic integrity would be improved in about 62 percent of the area. On about 4,200 acres, the scenic integrity would be maintained in the short term but would begin to deteriorate in the long term. While strategic placement of treatments would help to mitigate wildfire starts, there would still be a distinct possibility of similar effects from wildfire in the untreated areas as noted in the existing condition and No Action Alternative.

The existing road system used for hauling timber and/or biomass would be maintained and stable. Four miles of decommissioned roads would stabilized and be restored, improving scenic stability and scenic integrity. Temporary roads used for implementation would be restored. Over time this would maintain or improve scenic stability and scenic integrity. This alternative would result in slightly more improvement in both scenic stability and scenic integrity.

Cumulative Effects

Cumulative effects for this alternative would be the same as Alternatives 2 and 3 but to a somewhat lesser degree due to fewer acres proposed for treatment.

Irreversible and Irretrievable Commitments of Resources

The action alternatives focus on reduction of fuels to reduce the threat of high severity wildfire and subsequent flooding in two key areas near the City of Flagstaff, Arizona: the DLH portion of the Rio de Flag Watershed north of Flagstaff, and the MM portion of the Upper Lake Mary Watershed south of Flagstaff. As such, there is no irretrievable or irreversible commitment of scenic resources.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

Amendment 1: Modify Forest Plan language to allow mechanical treatments in MSO PACs up to 18 inches dbh and hand thinning treatments up to 9 inches dbh and prescribed burning within MSO nest/cores. The monitoring requirement specified under the Forest Plan would be amended to include the monitoring plan developed by the Forest Service, U.S. Fish and Wildlife Service, and the Rocky Mountain Research Station referenced in the following section titled, “Monitoring.” This amendment would also remove timing restrictions within MSO PACs for the duration of the FWPP project. Treatments within PACs would be accomplished as quickly as possible to reduce the duration of impacts, and would be coordinated with FWS. The purpose of this amendment would be to facilitate treatment in high-priority locations such as Mexican spotted owl occupied habitat to prevent high-severity wildfire. This is based on language in the

Mexican Spotted Owl Recovery Plan (2012), which states, “[wildfires] result in the most significant alteration of owl habitat and hence, have the greatest potential for loss of habitat.”

Effects to Scenic Resources

Amendment would have positive effects for many of the desired scenic character attributes as noted above and would improve scenic stability and improve scenic integrity. Since treatments would be coordinated with Fish and Wildlife Service to meet habitat requirements, it would also meet the desired condition of large old mature trees are a prominent component of the uneven aged forest. The form and shape of large trees and presence of a mature forest structure is critical to the landscape character of the ponderosa pine and mixed conifer types.

Amendment 2: Removing language restricting mechanical equipment to slopes less than 40 percent and language identifying slopes above 40 percent as inoperable. This amendment would allow mechanical harvesting on slopes greater than 40 percent within the project area.

It would be necessary to allow for use of specialized mechanical equipment to cut and remove trees on steep slopes to reduce the potential for high-severity wildfire in this project area due to the preponderance of areas with greater than 40 percent slope in the project area. Furthermore, since the Forest Plan was written and amended, mechanized ground-based equipment has progressed to be able to operate on steep slopes more effectively. While this specialized equipment is not commonplace in this region due to the high cost of its use, the approval of the City bond makes the use of such equipment a possibility for this project. In order to be able to utilize such equipment to treat slopes above 40 percent in the project area and meet the purpose and need, this Forest Plan amendment is needed.

Effects to Scenic Resources

Use of specialized equipment would have short term negative effects to scenery, but would enable much more treatment of vegetation than the current limits in the Forest Plan. Over the long term (10-20 years) there would be more improvement to scenic stability if the specialized equipment were able to operate on greater than 40 percent slopes than not. Since so much of the project areas are departed from historic conditions and at high risk from stressors including wildfire, intensive weather events, climate change and insects and disease these more intensive management actions are needed (Guido 2011). Scenic integrity would be maintained or improved over the long term as well.

Economics

This section will address the cost of implementing FWPP. This estimation includes the following costs: surveying and marking cultural sites, marking and cruising timber, road construction, road rehabilitation, road maintenance, preparing contracts, project administration, harvesting trees, hand thinning and prescribed burning. It does not include the cost of preparing the Environmental Impact Statement for the project.

Methodology

Implementation of the Flagstaff Watershed Protection Project would require several types of fuel reduction methods and other actions that are related to their implementation. Costs to undertake these activities have been estimated using a variety of methods. These costs are only estimates. Actual implementations cost, especially for logging systems not commonly used in northern

Arizona, may vary substantially. The activities that have been analyzed for and the methodology that was used to estimate their costs are:

Cultural Resource Survey Cost

A cultural resource survey and marking of cultural resource sites has already been completed for the project area. The project has been cleared for cultural resources. However if the chosen alternative includes temporary roads outside of existing, surveyed prisms, additional surveys may need to be performed. It is likely that these acres would be small and the survey completed “in house” by the Forest Service. These costs were provided by the Flagstaff District archaeologist, based on past experienced costs.

Sale Preparation Cost

Sale preparation costs are all costs associated with locating harvest units, timber marking and timber cruising. These costs were provided by the Flagstaff District timber management officer based on past experienced costs.

Sale Administration Cost

This is the cost to supervise the logging done by a contractor and to administer the contract. These costs were estimated by the Flagstaff District timber management office based on past experienced costs.

Temporary Road Construction and Rehabilitation Cost

This is the estimated cost for a contractor to construct new temporary roads and rehabilitate the road prism after use. It was estimated using the costs provided in the inter-regional cost guide.

Construction of Relocated System Roads Cost

This is the estimated cost for a contractor to build relocated system roads. It was estimated using the costs provided in the inter-regional cost guide.

Road Rehabilitation Cost (Not including new temporary roads)

This is the estimated cost for a contractor to rehabilitate existing system roads that are to be decommissioned, roads that are already decommissioned and in need of rehabilitation and existing non-system roads that are in need of rehabilitation. It was estimated using the costs provided in the inter-regional cost guide.

Prescribed Burning Cost

This is the cost to carry out prescribed burning. It was estimated by the Flagstaff District assistant fire management officer (fuels) based on past experienced costs.

Net Timber Value

Net timber value is the value of the timber to be harvested as it stands on the stump; it is also referred to as stumpage value. This is the monetary amount that a contractor would be willing to pay the government for the timber or the amount that the contractor would need to be paid in order to harvest and haul the timber from the site.

In May of 2012, the Forest Service awarded the Four Forest Restoration Initiative (4FRI) contract. This contract specifies a product value for each geographic working circle within the 4FRI contract area. 4FRI will be the major market for timber produced from the Flagstaff Ranger

District until at least 2021, which will be the end of the current contract period. The value of timber in the working circle that FWPP is located within, is a positive $3.50/ green ton for logs greater than 5 inches on the small end (i.e. the contractor pays the government for the timber) The material that is smaller than this, including limbs and tops, has a negative value of $3.50/green ton (i.e. the government pays the contractor $3.50/green ton to remove this material from the site).

This EIS assumes that these product values indicate the current market value for timber cut on FWPP for ground based harvesting. However due to the steep terrain on much of FWPP, more expensive logging systems capable of working on these steep slopes, such as skyline, steep slope cut to length and helicopter are under consideration. These systems would have a higher logging cost than conventional ground based logging. Conventional ground based logging has the lowest logging cost per ton of any logging system. In order to account for the cost of these higher priced systems and the effect they have on net timber value, logging cost was calculated for all systems and net timber value was adjusted to reflect the increased cost of these more expensive logging systems. For example if a ground based logging cost is calculated to be $25/ton and has a product value of $3/ton and a skyline logging system has a cost of $48/ton, then this increased cost would be subtracted from the ground based product value of $3/ton to show the net timber value of the timber harvested with a skyline system. This calculation would be: $3/ton (product value of a ground based system) - $23/ton (increased cost of a skyline system) = a negative $20/ton product value for the timber harvested with a skyline system. Trees down to a 4-inch dbh were used in logging cost calculations.

It is estimated that of the standing stem volume in the project area, 85 percent is sawlog size with a value to the government of $3.50/ton, and 15 percent is smaller than this with a value to the government of -$3.50/ton. This yields a composite value for $2.45/ton of stem material logged. It is also estimated that there is approximately 5 tons/acre of branches that would be bought in from the harvest units when stems are logged. This material can be burned at the landing or utilized. If it is utilized it would cost the government $3.50/ton to have it removed.

All logging cost was estimated using the Forest Service's log cost program (USDA FS, version 13.1).

Affected Environment

As discussed under Chapter 1, during the November 2012 elections, residents of Flagstaff, AZ approved a $10 million bond to support forest thinning work within key watersheds on the Coconino National Forest and State of Arizona lands. This is one of only a handful of examples in the country where fuels reduction work on the National Forests is being funded by a municipality, and the only known instance where such an effort is funded from municipal bonds. Additional funding for the planning effort has been leveraged from the Forest Service in order to retain as much of the bond money for implementation as possible.

Environmental Effects

Each alternative is discussed individually, followed by a comparison of costs by alternative (Table 142).

Alternative 1: No Action

Direct & Indirect Effects

Cultural Resource Cost

A contract for cultural resource survey has already been completed and a cost incurred.
Cultural resource survey = $72,000
Marking of cultural resource sites = $4,000
Forest Service Contract Admin. Cost = $26,000
Total Cultural Resource Cost = $102,000

Sale Preparation Cost

No sale preparation would be done under this alternative and no cost incurred.

Sale Administration Cost

No sale administration done would be under this alternative and no administrative cost incurred.

Temporary Road Construction and Rehabilitation Cost

No temporary roads would be built under this alternative and no costs incurred

Construction of Relocated System Roads

No road construction of relocated system roads would be done under this alternative and no cost incurred.

Road Rehabilitation Cost

No road rehabilitation would be done under this alternative and no cost incurred.

Hand Thinning Cost

No hand thinning would be done under this alternative and no cost incurred

Prescribed Burning Cost

No prescribed burning would be done under this alternative and no cost incurred.

Net Timber Value

No logging would be done under this alternative and no cost incurred or timber value generated.

Cumulative Effects

Cumulative effects do not apply to costs; costs are not effects.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Cultural Resource Survey and Site Marking Cost

Cultural resource survey = $72,000
Marking of cultural resource sites = $4,000
Forest Service contract administration cost = $26,000
Survey new road locations= $2,160
Total Cultural Resource Survey and Site Marking Cost = $104,160

Sale Preparation Cost

7,109 acres of sale preparation @ $120/acre = $853,080
4 task orders/timber sale contracts@ $4,500/contract = $18,000
Total sale preparation cost = $871,080

Sale Administration Cost

7,109 acres of timber sale to administer @ $50/acre = $355,450

Temporary Road Construction and Rehabilitation Cost

14.86 miles of temporary road construction and rehabilitation @ $15,089/mile = $224,223

Construction of Relocated System Roads

1.57 miles of system road relocated @ $11,885/mile = $18,659

Road Rehabilitation Cost

6.03 miles of road rehabilitations @ $9,319/mile =$56,194 (includes 1.44 miles of road 6277)

Hand Thinning Cost

846 Acres @ = $719,100/acre

Prescribed Burning Cost-

5,818 acres of slopes under 40% @ $500/acre =$2,919,546
3,107 acres of slopes over 40% @ $750/acre = $2,331,750
Total prescribed burn cost = $5,251,296

Net Timber Value

Net timber value under this alternative is a positive $274,908. Logging cost calculations for Alternative 2 are shown in Table 139.

Table 139: Logging cost summary, Alternative 2

Logging System	Stump to Truck Cost ($/tons)	Volume/ac (tons)	Acres	Total Volume (tons)	Timber Value ($/ton)	Net Timber Value by Logging System ($)
Ground-based Mechanical	$27	49	5818	285,082	+$2.45	+$698,451
Skyline-Machine Cut	$35	38.5	393	15,130	($5.55)	($83,971)
Skyline-Hand Cut	$41	38.5	271	10,433	($11.55)	($120,501)
Excaline-Machine Cut	$32	38.5	455	17,517	($2.55)	($44,668
Excaline-hand Cut	$37	38.5	172	6,622	($9.55)	($49,996)
Total			7109	334,784		
Non-stem Biomass	N/A	5	7109	35,545	($3.50)	($124,407)
Total Value						**+$274,908**

Cumulative Effects

There would be no cumulative environmental effects under this alternative.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Cultural Resource Survey and Site Marking Cost

Cultural resource survey = $72,000
Marking of cultural resource sites = $4,000
Forest Service contract administration cost = $26,000
Survey new road locations= $1,820
Total Cultural Resource Survey and Site Marking Cost = $103,820

Sale Preparation Cost

7,137 acres of sale preparation @ $120/acre = $856,440
4 task orders/timber sale contracts@ $4,500/contract = $18,000
Total sale preparation cost = $874,440

Sale Administration Cost

7,137 acres of timber sale to administer @ $50/acre = $356,850

Total Sale Administration Cost = $355,450

Temporary Road Construction and Rehabilitation Cost

10.13 miles of temporary road construction and rehabilitation @ $15,089/mile = $152,852

Construction of Relocated System Roads

1.57 miles of system road relocated @ $11,885/mile= $18,659

Road Rehabilitation Cost

6.03 miles of road rehabilitations@ $ 9,319/mile = $56,194 (includes 1.44 miles of road 6277)

Hand Thinning Cost

832 acres @ $850/acre = $707,200/acre

Prescribed Burning Cost-

5,818 acres of slopes under 40% @ $500/acre =$2,919,546
3,107 acres of slopes over 40% @ $750/acre = $2,331,750
Total prescribed burn cost = $5,251,296

Net Timber Value

Net timber value under this alternative is a negative $992,747. Logging cost calculations for Alternative 3 are shown in Table 140.

Table 140: Logging cost summary, Alternative 3

Logging System	Stump to Truck Cost ($/ton)	Volume/ac (tons)	Acres	Total Volume (tons)	Timber Value ($/ton)	Net Timber Value by Logging System ($)
Ground-based Mechanical	$27	49	5818	285,082	+$2.45	+$698,451
Steep Slope Cut to length	$33	38.5	346	13,321	($3.55)	($47,298)
Helicopter	$70	38.5	973	37,460	($40.55)	($1,519,003)
Total			7137	335,863		
Non-Stem Biomass	N/A	5	7137	35,685	($3.50)	($124,897)
Total Value						**($992,747)**

Cumulative Effects

There would be no cumulative environmental effects under this alternative.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Cultural Resource Survey and Site Marking Cost

Cultural resource survey = $72,000
Marking of cultural resource sites = $4,000
Forest Service contract administration cost = $26,000
Survey new road locations= $1,780
Total Cultural Resource Survey and Site Marking Cost = $103,780

Sale Preparation Cost

5,264 acres of sale preparation @ $120/acre = $631,680
2 task orders/timber sales @$4,500/each = $9,000
Total sale preparation cost = $640,680

Sale Administration Cost

5,264 acres of timber sale to administer @ $50/acre = $263,200
Total Sale Administration Cost = $263,200

Temporary Road Construction and Rehabilitation Cost

9.42 miles of temporary road construction and rehabilitation @ $15,089/mile = $142,138

Construction of Relocated System Roads

1.57 miles of system road relocated @ $11,885/mile= $18,659

Road Rehabilitation Cost

6.03 miles of road rehabilitations@ $ 9,319/mile= $ 56,194 (includes 1.44 miles of road 6277)

Hand Thinning Cost

438 Acres @ = $372,300/acre

Prescribed Burning Cost-

5,297 acres of slopes under 40% @ $500/acre =$2,648,500
505 acres of slopes over 40% @ $750/acre = $378,750
Total prescribed Burn cost =$3,027,250

Net Timber Value

Net timber value under this alternative is a positive $539,823. Logging cost calculations for Alternative 4 are shown in Table 141.

Table 141: Logging cost summary, Alternative 4

Logging System	Stump to Truck Cost ($/ton)	Volume/ac (tons)	Acres	Total Volume (tons)	Timber Value ($/ton)	Net Timber Value by Logging System ($)
Ground-based Mechanical	$27	49	5,264	257,936	+$2.45	+$631,943
Total			5,264	257,936	+$2.45	+$631,943
Non-Stem Biomass		5	5,264	26,320	($3.50)	($92,120)
Total Value						**+$539,823**

Cumulative Effects

Cumulative effects do not apply to costs; costs are not effects.

Comparison of Costs by Alternative

A comparison of costs to implement this project is shown in Table 142. All costs are subtracted from net timber value to arrive at a total estimated cost to implement the project.

Table 142: Comparison of costs per alternative

	Alternative 1	**Alternative 2**	**Alternative 3**	**Alternative 4**
Cultural Resource Survey Cost	$102,000	$104,160	$103,820	$103,780
Sale Preparation Cost	$0	$871,080	$874,440	$640,680
Sale Administration Cost	$0	$355,450	$356,850	$263,200
Temp Road Construction and Rehabilitation	$0	$224,223	$152,852	$142,139
Construction of Relocated System Roads Cost	$0	$18,659	$18,659	$18,659
Road Rehabilitation Cost	$0	$56,194	$56,194	$56,194
Hand Thinning	$0	$719,100	$707,200	$372,300
Prescribed Burning	$0	$5,251,296	$5,251,296	$3,027,250
Costs of Implementation, (not including net timber value)	$102,000	$7,600,162.00	$7,519,491	$4,622,422
Net Timber Value	$0	+$274,908	($992,747)	+$539,823
Total Implementation Cost (Net Timber Value minus Cost of Implementation)	**($102,000)**	**($7,323,094)**	**($8,512,238)**	**($4,082,599)**

Socio Economics

Methodology

NVUM: Data on visitor demographics and preferences regarding activities, spending, and trip characteristics were available for the Forest from the National Visitor Use Monitoring (NVUM) program (English et al. 2002). The NVUM is a highly useful data source because it is based on study design specifically meant to provide data to forest managers to infer recreational use and patterns on the Forest. This data source is based on site-specific surveys, which means the estimates are based on actual activities users have participated in at the time of the survey rather than those activities that users report they have once or will participate in at some unidentified time and location. The Socio-Economic Specialist Report contains more information about the NVUM.

This analysis addresses implementation of FWPP-related treatments on the Coconino National Forest.

Social impacts use the baseline social conditions presented in the National Visitor Use Monitoring (NVUM) profiles (USFS 2011a and USFS 2011b), and information from the Coconino Economic and Social Sustainability Assessments (USFS 2008a, USFS 2008b) to discern the primary values that the Forests provide to area residents and visitors. Social effects are based on the interaction of the identified values with estimated changes to resource availability and uses. Additionally, key determinants of quality of life that may be affected by FWPP treatments were identified through scoping and on-going public involvement.

Assumptions

1. The economic impact analysis for recreation assumes that 10 percent of the project area would be unsuitable for recreational use at any given time during the 10-year treatment period. Ten percent of the project area translates to approximately 1,054 acres, even though not all 10,544 acres within the project area are proposed for treatment, and only the Dry Lake Hills portion experiences heavy recreational use (see Recreation Specialist Report, 2014).

2. Ten percent of the FWPP project area translates to approximately .00058 percent of the total acreage of the Coconino National Forest[33]. The recreation analysis is conducted at the forest level, for consistency with recreation use reporting methods.

3. Trees less than five inches in diameter are classified as woody biomass for the purposes of the economic impact and economic efficiency analyses. Trees greater than five inches in diameter are classified as timber.

Resource Indicators and Measures

Table 143 identifies the indicators used to measure changes between alternatives related to social and economic well-being in the planning area.

[3333] The proposed FWPP area is 10,544 acres. The Coconino NF is composed of approximately1.8 million acres.

Table 143: Socioeconomic Indicators

Category	Indicator(s)
Economic activity	Employment and labor income; income from recreation and tourism
Economic efficiency	Public expenditures, avoided costs, lost activity days, tourist spending, and ecosystem services provision
Quality of life	Smoke emissions, traffic, recreation displacement, scenery changes
Environmental justice	Smoke emissions in low-income and tribal communities, employment and labor income

Affected Environment

Existing social and economic conditions are necessary to establish the baseline from which to estimate potential consequences of the FWPP proposed activities. The proceeding section analyzes the current conditions and trends related to the social and economic environment of the planning area, including: population and demographic changes, potential environmental justice populations, and employment and income conditions.

Population and Demographics

This section highlights population and demographic trends in the study area. Population is an important consideration in managing natural resources. In particular, population structure (size, composition, density, etc.) and population dynamics (how the structure changes over time) are essential to describing the consequences of forest management on the social environment (Seesholtz et al. 2004).

Population Growth

The study area is home to approximately 134,421 people (U.S. Census Bureau 2010). Table 144 displays population data for the county, state, and nation in 1990, 2000, and 2010.

Table 144: Population Change, 1990-2000 and 2000-2010

	1990	*2000*	*% Growth, 1990-2000*	*2010*	*% Growth, 2000-2010*
Coconino County	96,591	116,320	20.4%	134,421	15.6%
Arizona	3,665,228	5,130,632	40.0%	6,392,017	24.6%
United States	248,709,873	281,421,906	13.2%	308,745,538	9.7%

Source: U.S. Census Bureau, 1990, 2000, and 2010

The study area population growth rate mirrored Arizona's population growth rate during the two periods and surpassed the national population growth rate in both periods.

Rapid population growth may signal expanding economic opportunities and/or desirable amenities. Much of Coconino County is occupied by protected federal lands. National Forest System (NFS), Bureau of Land Management (BLM), and National Park Service (NPS) lands provide natural amenities for area residents.

Population Density

Population density can serve as an indicator of a number of socioeconomic factors of interest – urbanization, availability of open space, socioeconomic diversity, and civic infrastructure (Horne and Haynes 1999). More densely populated areas are generally more urban, diverse, and offer better access to infrastructure. In contrast, less densely populated areas provide more open space, which may offer natural amenity values to residents and visitors. Table 145 displays the number of people per square mile for each of the counties of interest.

Table 145: Population Density

	People/Sq. Mile
Coconino County	7.2
Arizona	56.3
United States	86.6

Source: U.S. Census Bureau 2010, Table DP-1

Despite substantial gains in population since 1990, Coconino County continues to have relatively low population density, and is less dense than the state and nation. These findings suggest that the study area is quite rural. Low population density also points to high levels of public ownership. A minority of the land is privately owned, and the majority of land is publicly owned (Forest Service, BLM, and State Lands) or Indian reservation land (Arizona Department of Commerce 2008).

Median Age

Table 146 lists the median age by county for the study area. As with other population characteristics, the median age varies substantially between counties. Coconino County is relatively young with a median age below the state and national medians. A high median age generally indicates that a relatively large number of retirees reside in the area. An area with a large percentage of retirees will earn income primarily from investments and transfer payments (e.g., dividends and Social Security), rather than salaries and wages.[34]

Table 146: Median Age

	Median Age
Coconino County	31.0
Arizona	35.9
United States	37.2

Source: U.S. Census Bureau 2010, Table DP-1

Age data may be relevant for Forest management decisions. A population's age may affect community values and uses associated with Forest lands. For example, older populations are more likely to desire easily accessible recreation opportunities.

[34] This prediction is borne out in the non-labor income data presented in Table 154. More than 50 percent of the income in Yavapai County comes from non-labor sources.

Educational Attainment

Educational attainment, the measure of people with at least a high school diploma or bachelor's degree, is an important indicator of an area's social and economic opportunities and its ability to adapt to change. Table 147 lists the percentage of the adult population with at least a high school diploma and a bachelor's degree.

Table 147: Educational Attainment, Percent of Persons Age 25+

	High School Graduate (%)	*Bachelor's Degree or Higher (%)*
Coconino County	85.7	31.3
Arizona	85.6	25.9
United States	85.6	28.2

Source: U.S. Census Bureau 2010, Table DP02

The vast majority of adult residents in the study area are high school graduates. Approximately a quarter of study area residents have a bachelor's degree or higher. These findings suggest that the study area is relatively well-educated. Opportunities likely exist for working-age adults with high levels of education. The presence of highly educated adults may be self-reinforcing: a highly educated population is a signal that an area provides economic and cultural opportunities, which attracts additional college educated adults to the area. This process leads to further economic development and job creation. In contrast, areas with low levels of educational attainment have lower levels of human capital, which reduces an area's ability to capitalize on economic change (Florida 2002).

There are a number of institutions of higher education in the study area, including Northern Arizona University and Coconino Community College. Post-secondary institutions improve a county's ability to retain and attract young residents. In areas without higher educational opportunities, young people who wish to continue their education migrate out of the area – a process known as the "brain drain."

Employment and Income

The previous section assessed demographic trends in the study area relative to the state and national averages. This section will focus on economic conditions and trends in the study area. This discussion provides additional information on the social and economic environment in the study area. The baseline analysis is the foundation of subsequent impact analyses.

Per Capita Income

Per capita income is a key indicator of the economic well-being of a county. High per capita income may signal greater job opportunities, highly skilled residents, greater economic resiliency, and well-developed infrastructure. Table 148 provides data on per capita income in 2010 for the county, state, and nation.

Table 148: Per Capita Income, 2010 US Dollars

	Per Capita Income
Coconino County	$19,703
Arizona	$23,618
United States	$26,059

Source: U.S. Census Bureau 2010, Table DP03

Per capita income in the study area is similar to per capita income in the state and nation. Coconino County has a lower per capita income than the state and national levels, which is consistent with the finding in the **Error! Reference source not found.** section that Coconino County has a higher poverty rate relative to the state and the nation.

Median Earnings

Per capita income offers an incomplete picture of the economic well-being of an area. Table 149 presents data on median earnings for workers. Whereas per capita income considers all sources of income (including wage and salary payments, transfer payments, investment earnings, dividends, and rents), median earnings considers only wage and salary earnings.

Table 149: Median Earnings for Workers, 2010 US Dollars

	Median Earnings
Coconino County	$19,921
Arizona	$27,813
United States	$28,899

Source: U.S. Census Bureau 2010, Table DP03

Median earnings in Coconino County are below state and national medians. Median earnings are slightly higher than per capita income in Coconino County, which suggests that employed residents have slightly higher incomes than individuals who do not derive income from employment (e.g., retirees).

These demographic statistics point to a County that has much more public lands than average and has a faster than average growing population that is predominantly well educated and young. A younger, more educated population with lower-than average median income are exactly those most likely to spend time recreating on the National Forest and other nearby public lands. This information suggests that there is likely to continue to be a high demand for nearby recreational opportunities on the Forest and that this opportunity is an important quality of life issue.

Forestry-Related Employment and Income

Table 150 shows the economic contribution of forestry-related sectors to the local economy. In terms of employment, forestry-related sectors account for approximately one-quarter of one percent of study area employment. This is less than the statewide contribution, where forestry-related jobs account for approximately 0.63 percent of total employment. The same trend is observed in employee compensation and output – the forestry sector in the study area is relatively smaller than in other parts of the state. These findings indicate that the study area is currently less specialized in forestry than the rest of the state.

Table 150: Economic Contribution of Forestry-Related Sectors in the Study Area

	Employment		**Employee Compensation (in USD Millions)**		**Output (in USD Millions)**	
	Value	*% of Total*	*Value*	*% of Total*	*Value*	*% of Total*
Coconino County	182	0.25%	$4	0.13%	$15	0.19%

Arizona	20,169	0.63%	$575	0.42%	$1,713	1.26%

Source: MIG 2009

Recreation Use

Based on the NVUM data, a total of 2.87 million individuals visited the Coconino National Forest in FY 2010 (see Table 151). Of the 642 visitors surveyed, the majority reported being from Coconino County (11.8 percent); the next highest percentage were from foreign countries (5 percent), with the majority of the remaining visitors from either Yavapai or Maricopa counties (NVUM 2011).

Table 151: Annual visitation estimate (thousands) for the Coconino National Forest (data from the Coconino National Forest NVUM, 2011)

Site Visit	Visits (thousands)
Total Estimated Site Visits	4,715
Developed Day Use Sites	2,244
Developed Overnight Use Sites	128
Undeveloped Areas	1,842
Wilderness	501
Total Estimated Coconino National Forest Visits	2,868

According to the NVUM, the spending that occurs on a recreation trip is greatly influenced by the type of recreation trip taken. Visitors who have not traveled far from home to the recreation location usually spend less than visitors traveling longer distances, especially on items such as fuel and food (NVUM 2009). Seven trip type segments have been identified to help explain differences in spending of distinct subgroups of visitors (Stynes and White 2005a):

National Forest Visitor Trip Type Segments

1. **Non-local day trips**: Non-local residents on day trips
2. **Non-local OVN-NF**: Non-local residents staying overnight on the NF
3. **Non-local OVN:** Non-local residents staying overnight off the NF
4. **Local day trips**: Local residents on day trips
5. **Local OVN-NF**: Local residents staying overnight on the NF
6. **Local-OVN**: Local residents staying overnight off the NF
7. **Non-Primary**: Visits where recreating on the NF is not the primary trip purpose.

Local visitors are defined as living within 50 miles of the recreation site[35]. Overnight visitors are those that reported being away from home more than 24 hours on their trip[36]. The overnight on

[35] Formally, locals were defined using the zipcode variable to determine the straight-line distance from the center of the zipcode to the forest boundary. Distances of 30 miles or less were defined as locals. Taking into account the additional distance from the forest boundary to the recreation site, distances from the residence to zipcode centroid and road circuity, locals should be interpreted as living within roughly a 50 mile driving distance of the site.

NF segments are composed of those visitors who stated that they spent the previous night on the national forest. The "non-primary" segment covers visitors who reported recreating at other areas on the trip and did not identify the NF as their primary destination[37].

According to the National Summary Report (2010) average spending on a party trip basis was as follows:

Table 152: Average spending per trip from the National NVUM (2010)

	Non-local Segments			Local Segments			Non-primary*
	Day	Overnight on NF	Overnight off NF	Day	Overnight on NF	Overnight off NF	
People per Party	2.5	2.6	2.6	2.1	2.8	2.3	2.5
Local area direct spending per party per visit	$73.16	$236.75	$605.93	$37.03	$171.47	$195.14	$37.03

*Non-primary visits are assigned the same spending total as local day visits as that is the best approximation of the additional spending created by the National Forest Visit.

In FY 2003 the NVUM survey defined overnight trips more precisely, including the identification of lodging types in the local area. Visitors staying in motels, cabins or lodges averaged $362 per trip, compared to $281 for visitors camping off the forest, $187 for visitors staying in private homes, $138 for visitors staying in developed NF campgrounds and $115 for visitors staying in undeveloped NF campsites (Stynes and White 2005b).

Table 153 shows the distribution of visits to the Coconino National Forest.

Table 153: Distribution of National Forest Visit by Spending Segment on the Coconino National Forest (FY2005)

	Non-local Segments			Local Segments			Non-Primary	Total
	Day	Overnight on NF	Overnight off NF	Day	Overnight on NF	Overnight off NF		
Visits	305,155	174,948	696,637	941,851	62,809	6,883	679,716	2,867,999

[36] As the survey in the first three years did not measure nights spent in the local area, the overnight segments will include some visitors on extended trips that do not spend any nights locally. Spending reports were restricted to spending within 50 miles of the site.

[37] The trip purpose question was modified in FY2003 to more directly ask if the primary purpose was recreation on "this" NF, recreation elsewhere, or for business, visiting friends and relatives or other purposes. This change increased the percentage of non-primary purpose trips from 7% to 12%. See Stynes and White (2005b) for details.

Percent of CNF Visits	10.64	6.10	24.29	32.84	2.19	0.24	23.70	100.0

As shown in Table 153, the highest percent of recreational visits to the Coconino National Forest were comprised of local day visits, and the next highest percent of visits were those who visited but spent the previous night off forest. Nearly one-quarter of visits to the Coconino National Forest are made as side trips during a visit to some other recreation destination.

According to the FY2010 data for the Coconino National Forest, the average total trip spending per party equaled approximately $562, with a median total trip spending per party of $100.

Economic Diversity

Economic diversity generally promotes stability and offers greater employment opportunities. Highly specialized economies (i.e., those that depend on very few industries for the bulk of employment and income) are prone to cyclical fluctuations and offer more limited job opportunities. Determining the degree of specialization in an economy is important for decision-makers, particularly when the dominant industry can be affected by changes in policy. For Forest Service decision-makers, this is likely to be the case where the forest products industry or the tourism and recreation industries, for instance, are reliant on the local National Forest(s).

Coconino County, which has a larger tourism base to its economy than average, has a relatively high percentage of accommodations and food services and arts, entertainment and recreation compared to surrounding counties. While the City of Flagstaff economy accounts for between 50 and 60 percent of Coconino County output, the County has a larger tourism base than most because it includes portions of Grand Canyon National Park, which is a national and international recreation destination.

Non-Labor Income

Table 154 displays the role of labor and non-labor income in total personal income for 2000 and 2009. Non-labor income is any income derived from investments, dividends, rents, or transfer payments. In contrast, labor income is salary and wage disbursements from employment. During the past decade, the percentage of total income derived from non-labor sources increased in all considered areas.

Non-labor income is not directly tied to employment; therefore, it can be more resistant to economic downturns. However, as the most recent recession demonstrated, asset markets can be quite volatile, and non-labor income that depends on investment returns may be unstable.

An increase in non-labor income may reflect changing demographic characteristics. Older populations rely largely on non-labor income, including rents, dividends, and transfer payments (e.g., Social Security). High percentages of non-labor income likely indicate higher concentrations of retirees.

Table 154: Contribution of Labor and Non-Labor Income to Total Personal Income, 2000 and 2009

	2000		***2009***	
	Labor %	***Non-Labor %***	***Labor %***	***Non-Labor %***

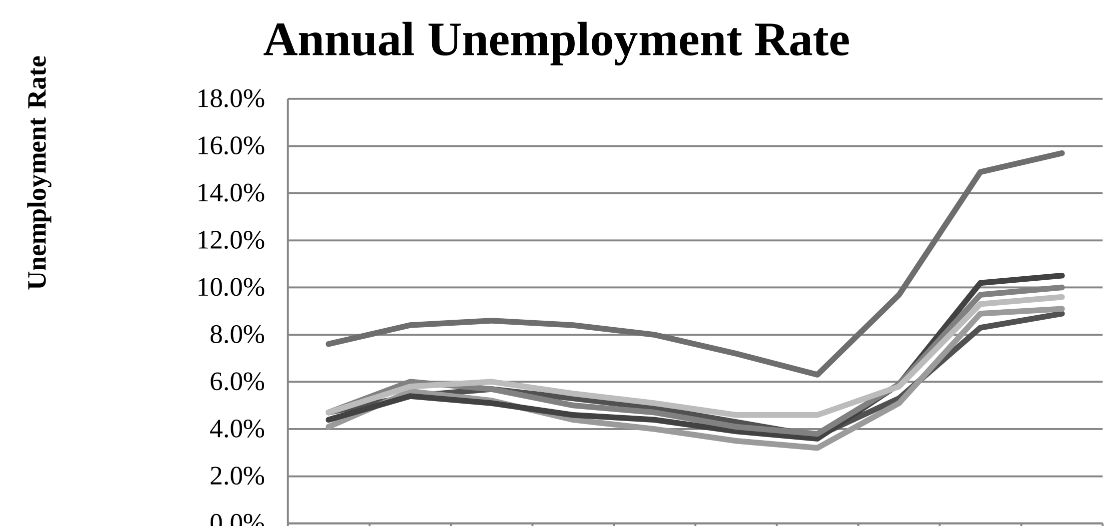
Coconino County	64%	36%	62%	38%
Arizona	68%	32%	62%	38%
United States	69%	31%	64%	36%

Source: U.S. Bureau of Economic Analysis 2011a

The distribution of labor and non-labor income in Coconino County mimics the state and national distributions.

Unemployment

The unemployment rate provides insight into the correspondence between residents' skills and employment opportunities. The "natural" rate of unemployment is said to be around 5 percent. This is the so-called "natural" rate because this is a level that allows for movement between jobs and industries, but does not signal broad economic distress. Recently, the national unemployment rate has hovered between 8 and 10 percent. Figure 94 provides the annual unemployment rates for the counties, state, and nation from 2001 to 2010. As shown by Figure 1, unemployment trends in Coconino County have mirrored state and national rates.



	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Coconino County	4.7%	5.4%	5.7%	5.3%	4.9%	4.3%	3.7%	5.3%	8.3%	8.9%
Maricopa County	4.1%	5.6%	5.2%	4.4%	4.0%	3.5%	3.2%	5.1%	8.9%	9.1%
Navajo County	7.6%	8.4%	8.6%	8.4%	8.0%	7.2%	6.3%	9.7%	14.9%	15.7%
Yavapai County	4.4%	5.4%	5.1%	4.6%	4.4%	3.9%	3.6%	5.9%	10.2%	10.5%
Arizona	4.7%	6.0%	5.7%	5.0%	4.7%	4.1%	3.8%	5.9%	9.7%	10.0%
United States	4.7%	5.8%	6.0%	5.5%	5.1%	4.6%	4.6%	5.8%	9.3%	9.6%

Figure 94: Annual Unemployment Rate, 2001-2010

Source: U.S. Bureau of Labor Statistics 2011

Economics of Wildfire

Wildfire Costs

Annually, millions of dollars are spent on suppression of wildfires in the United States. In 2007, there were 27 large fires in the U.S. that cost $547 million to suppress (WFLC 2010). Between 2000 and 2008, the percentage of the Forest Service budget spent on extinguishing wildfires expanded from 25 to 44 percent (WFLC 2010). Furthermore, suppression costs account for only a fraction of the total cost of wildfires. The Western Forestry Leadership Coalition (WFLC) estimates that total wildfire-related expenses range from two to thirty times the reported suppression costs (2010).

The rising cost of federal wildland fire operations has caused a shift of agency expenditures from other mission critical activities (e.g., restoration, research, and recreation) toward firefighting and fire management (Vilsack 2014). Reduced funding for recreation, vegetation and watershed management, wildlife and fisheries habitat management, and other non-fire activities limits the ability of the Forest Service to contribute to improvements in ecosystem services and quality of life in nearby communities (Vilsack 2014).

Wildland-Urban Interface

As explained above, the cost of fighting wildfires increased over the past decade. A principal reason for the increasing cost is the growing number of homes located in the wildland-urban interface (WUI). Suppression activities are frequently undertaken when wildfire threatens private property. A century of fire suppression has led to increased frequency of high-intensity wildfire. The spread of the WUI has increased the probability that wildfires will occur near private residences. These two factors – the growth of the WUI and the use of suppression tactics – increase the cost of wildfire. Table 155 presents the extent of the wildland-urban interface (WUI) in Coconino County, other Arizona counties and the western United States.

Table 155: Wildland-Urban Interface, Planning Area and West-Wide

	WUI Area with Homes (2000)	***WUI Homes as % of Total Homes (2000)***	***West-Wide Rank by Existing Wildfire Hazard (2000)***
Coconino County	21.5%	25.6%	55 of 413
Maricopa County	16.9%	0.3%	161 of 413
Navajo County	26.5%	18.7%	93 of 413
Yavapai County	23.5%	9.7%	71 of 413
Western U.S.	13.9%	3.9%	N/A

Source: Gude et al 2008

One-quarter of Coconino County homes are located within the WUI. Coconino County is also in the top quintile for existing fire risk. These factors make it more likely that the study area will experience large, expensive wildfires.

Costs Post-Wildfire

After the 2010 Schultz Fire and subsequent flooding events, the Ecological Restoration Institute (ERI) of Northern Arizona University put together a study called A Full Cost Accounting of the 2010 Schultz Fire, which detailed not only the cost of wildfire suppression, but also those associated with loss of property value and specific flood damage to property (2013). According to this study, the total impact of the Schultz Fire was estimated at between $133 million and $147 million. This is considered a conservative estimate as it “excludes measures such as volunteer work by nonprofits; destruction of recreation areas, timber, and archaeological sites; physical and mental health costs’ the degraded viewshed (beyond effects on property values); and the long-term impacts to the region’s amenity-based economy” (ERI 2013). Table 156 is pulled from the Flagstaff Watershed Protection Project Cost Avoidance Study completed by the Rural Policy Institute at Northern Arizona University (2014), which updated the figures to 2014 dollars for comparison with costs avoided by FWPP. More information on that study can be found later in this report, in the Total Avoided Costs section under the Summary of Effects.

Table 156: Response and Remediation Costs, Schultz Fire and Flood (adjusted to 2014 dollars) (RPI 2014)

Funding Agency	Expense
City of Flagstaff	$5,451,721
Coconino County	$14,821,116
Arizona Division of Emergency Management (ADEM)	$1,135,149
Arizona Department of Transportation (ADOT)	$3,038,074
Fire Department	$147,100
Natural Gas Utilities	$182,600
Electrical Utilities	$115,000
Water Utilities	$89,434
Federal Emergency Management Agency (FEMA)	$5,722,000
US Forest Service (USFS)	$14,395,200
Natural Resources Conservation Service (NRCS)	$7,650,000
Federal Highway Administration (FHWA)	$6,200,000
Total	**$58,947,394**
Adjusted to 2014 dollars	**$61,169,000**

(Dustin Woodman, Coconino County)

Ecosystem Services (Non-Market Values)

The economic value of Forest Service management is not entirely captured in market transactions. Much of the value of National Forests is “non-market” in nature – meaning that many of the benefits that forests provide to humans do not have a price. The lack of a price, however, should not be conflated with an absence of value. Indeed, non-market values from forests provide economic benefits to adjacent communities and forest visitors.

Ecosystem services are “components of nature, directly enjoyed, consumed, or used to yield human well-being” (Boyd and Banzhaf 2007) and include both market and non-market values. Healthy forests provide numerous ecosystem services, including clean water and air, biodiversity, forest products, and many other goods and services. Consistent with direction provided in 40 CFR 1502.23 and Forest Service Handbook 1909.15 (7/06/04) and 22.35 (01/14/05), the analysis of environmental consequences will consider non-market goods and services primarily in qualitative terms. Where appropriate, discussion of how the alternatives may affect other, non-market, ecosystem services will be presented. However, due to the qualitative nature of these discussions, direct comparisons between changes in market and non-market values are generally not possible.

Environmental Effects

Summary of Effects

Economic Consequences

As the total FWPP acreage is such a small percentage of the Coconino National Forest (less than .001 percent), none of the alternatives are anticipated to affect regional economics.

A breakdown and analysis of employment and labor income consequences are addressed below and in the alternative-specific descriptions of consequences.

Tourism and Visitor Spending
According to the National Visitor Use Monitoring (NVUM) reports, there are approximately 2,868,000 visits to the Coconino NF (USFS 2011). It is unknown what portion of these visits occurs in the FWPP area. At any given time during the 10-year treatment period, approximately .00058 percent of the Coconino NF would not be suitable for recreational use due closures to ensure public safety during active use of heavy equipment.

According to the Recreation Specialist Report for FWPP(Poturalski 2014), the majority of the recreational use that occurs on the Coconino National Forest and the FWPP project area is local day use (hiking, biking, nature viewing, etc.). As there are many substitutes for such activities elsewhere on the National Forest within Coconino County, people are not likely to leave the County or the Forest when the closures occur. Recreational users are likely to find nearby substitutes on the Coconino National Forest or adjacent public lands, and so none of the alternatives is expected to change the economic contribution from recreation. Although the FWPP treatments would make portions of the forests temporarily unsuitable for recreational use, most visitors would engage in substitute behavior that would also contribute to the local economy (e.g., visiting an alternate site on the forest, visiting nearby national parks, state parks, or other public lands). Annually, the FWPP treatments could affect about 2,109 acres of the approximately 2.8 million acres of the Coconino (two percent of the total acreage). Therefore, the probability that visitor use would be substantially disturbed is low within the Coconino National Forest.

Wildfire Costs
Central to the economic efficiency analysis of forest treatment is the relationship between treatment (prescribed burning and thinning, in the case of the FWPP) and wildfire risk (incidence) and hazard (severity) reduction. Mercer (2000) notes that treatment is associated with a decrease in wildfire suppression costs and a decrease in net resource damage. Closely related to the costs of wildfire is the subsequent costs of flooding post-fire. The section focuses on the costs of wildfire suppression and is primarily descriptive in its analysis of tradeoffs.

Direct costs include only expenses associated with personnel and supplies used to suppress a wildfire. Federal and state budgets are finite – and increasingly limited in recent years. The direct cost of extinguishing a wildfire can be devastating for state and federal agencies. From 2000 to 2008, wildfire suppression funding increased from 25 percent to 44 percent of the U.S. Forest Service budget (WFLC 2010). The more money spent suppressing wildfires, the less funding remains for activities that promote forest health and improve the quality of recreation opportunities for visitors.

Table 157 displays historic wildfire expenditures[38] of the Coconino National Forest.

Table 157: Historic Wildfire Suppression Costs, by Forest

	Coconino National Forest
2006	$11,554,537
2007	$5,473,007
2008	$1,181,338
2009	$6,081,460
2010	$13,500,703
2011	$5,137,758
Average Annual Expenditure	**$7,154,801**

Source: Forest Service Fire Ecology and Budget Staff, Coconino and Kaibab National Forests

Wildfire costs are very difficult to predict because wildfires range enormously in size, terrain, and proximity to local communities. All of these factors will affect the direct cost of dealing with a wildfire. The Wallow Fire of summer 2011, for instance, cost more than $79 million to extinguish (WMI 2011). However, not all wildfires need to be extinguished. Fire is a natural part of the landscape and unnecessary wildfire suppression leads to fuel buildup and increased fire risk and hazard.

Suppression costs are generally only a small component of the total cost of a wildfire. The Western Forestry Leadership Coalition finds that the total cost of wildfire ranges from two to 30 times greater than the suppression cost (WFLC 2010). A full cost accounting of the 2010 Schultz Fire, which occurred in the vicinity of the 4FRI project area, estimated that the fire cost between $133 million to $147 million (Combrink et al 2013). Forest Service expenditures associated with the fire accounted for $14.4 million (Combrink et al 2013). For context, historic wildfire suppression costs data are presented in Table 157.

Total Avoided Costs

In 2014, the Rural Policy Institute (RPI) of Northern Arizona University conducted a study that estimated the potential financial damages mitigated by the implementation of FWPP (October 2014). This study, known as the Flagstaff Watershed Protection Project Cost Avoidance Study (or

[38] Wildfire suppression and wildfire use expenditures are reported together. However, according to the budget and fire staff, suppression accounts for the vast majority of the reported expenditures.

Cost Avoidance Study), found that between the two treatment areas, potential financial damages range from $573 million to $1.2 billion (see Table 158).

The Cost Avoidance Study uses data from the Army Corps of Engineers' *Rio De Flag, Flagstaff, Arizona, Economic Reevaluation Report*[39], and the Ecological Restoration Institute's *A Full Cost Accounting of the 2010 Schultz Fire*[40]. The former study includes in-depth estimates of assets at risk downstream of the Dry Lake Hills. The latter estimates the costs associated with the Schultz Fire, including response and mitigation, loss of property values, and specific flood damage to property.

Table 158 lists the high and low estimated damages that the Flagstaff Watershed Protection Project hopes to mitigate. The estimates have been adjusted to 2014 dollars and they are divided between the two watersheds. In the Dry Lake Hills they are estimated between $489 and $986 million. In the Mormon Mountain area they are estimated between $84 and $215 million (RPI 2014).

Table 158: Summary of potential costs (low to high) associated with a severe wildfire and subsequent flooding in the FWPP area

Source	Low	High
	($) millions	($) millions
	Dry Lake Hills	
Government and Utilities	43	43
Structures and Contents	132	286
Property Value	256	524
Habitat	0.4	15
Communication Towers	30	80
BNSF Railroad Interruption	12	23
Retail Sales	15	15
Dry Lake Hills Total	**$489 million**	**$986 million**
	Mormon Mountain	
Government and Utilities	12	12
City Water Supply	17	37
Habitat	1	22
Communication Towers	54	144
Mormon Mountain Total	**$84 million**	**$215 million**
Total, Both Areas	**$573 million**	**$1,201 million**

Health Impacts

[39] *Rio De Flag, Flagstaff, Arizona, Economic Reevaluation Report.* The U.S. Army Corps of Engineers. 2011.

[40] *A Full Cost Accounting of the 2010 Schultz Fire.* The Ecological Restoration Institute. Northern Arizona University. 2012.

Smoke is inevitable in the airsheds of northern Arizona, whether from wildfire or prescribed fire. Smoke can travel great distances and affect communities far away from the burn unit, sometimes persisting after the burn has been completed. Fires burning under historic conditions (wildfire or prescribed fire) produce behavior and effects that are low to moderate. Fires that burn under more extreme conditions (most/all fires in this category are wildfires) produce behavior and effects that are moderate to severe.

Ambient particulate matter (PM) concentrations increase substantially during a wildfire (Kochi et al 2010b). A dose-response function is an equation that estimates the health consequences of exposure to pollution. Compared to conventional PM studies (based on urban air pollution), wildfire studies are "less likely to find a significant positive mortality effect in spite of the substantial increases in PM levels during the wildfire period" (Kochi et al 2010a). There are several probable reasons for this finding, including: (1) urban air pollution and wildfire smoke are chemically different (wildfire smoke is generally less toxic), (2) wildfire events are more likely to promote averting behavior, such as evacuation (Kochi et al 2010a). However, the wildfire studies did find increased hospital admissions linked to asthma and respiratory problems during wildfire events (Kochi et al 2010a). PM studies find that the dose-response function is not linear. In other words, a doubling of PM concentration more than doubles the health consequences. Furthermore, at low-levels an increase in PM may result in no measureable health consequences (Kochi et al 2010b).

Five key health outcomes are considered in the literature: (1) mortality, (2) restricted activity days, (3) hospital admissions, (4) respiratory symptoms, and (5) self-treatment. Kochi et al (2010b) estimate that the cost of health effects due to smoke from wildfire events range from $0.26 million to $1.2 billion depending on the scale of the fire and the health outcomes considered.

The timing of prescribed fires is predictable, the volume of smoke produced is far less than in a wildfire, and there is time to notify the public when burns will be implemented. As a result, adverse health consequences are less likely to result from prescribed fires.

Tourism

During wildfire events, tourism decreases due to evacuations, road closures, and negative publicity (Mercer et al 2000). Depending on the size and intensity of the wildfire, impacts to tourism may be long-lasting. For instance, the 2002 Rodeo-Chediski fire burned 106 miles of trails on the Apache-Sitgreaves National Forest (Morton et al 2003). Recreation and tourism displacement can reduce contributions to the local economy (discussed above in the Tourism and Visitor Spending section). In addition to the costs to local businesses, individuals may have lower consumer surplus[41] values if they must recreate at a substitute site due to the presence of fire or smoke.

Knotek et al (2008) find that local visitors are more accepting of prescribed fire than non-local visitors are. This finding may be due to (1) better communication between federal agencies and local residents, (2) more local familiarity with the role of fire in the landscape, or (3) more opportunities to engage in substitute behavior.

Ecosystem Services

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[41] Consumer surplus is the value that individuals receive above what is paid to consume the good or service. For instance, if an individual pays $10 to recreate at a site, but would be willing to pay $25, his/her consumer surplus is $15.

Wildfire has the potential to reduce ecosystem service values through: (1) destruction of wildlife habitat, (2) water quality and watershed impacts, (3) damage to cultural and archaeological sites, and (4) soil erosion and impacts to water quality (Morton et al 2003). In contrast, forest restoration and fuels reduction work has the potential to improve ecosystem services. Though the primary focus of FWPP is reduction in the potential for high severity wildfire and subsequent flooding, other ecosystem service benefits are also anticipated, such as increased resiliency to climate change. The anticipated ecosystem service benefits include:

- Reduction of unnaturally large wildfires
- Protection of watersheds, leading to increases in surface water and decreases in soil loss
- Diversification of understory composition and protection of rare habitat from fire
- Better management of wildlife habitat
- Enhanced recreation that is aesthetically pleasing
- Sequestering carbon in large trees and soils (Combrink et al 2012).

Social Consequences

In addition to effects on the local economy, activities associated with FWPP have the potential to affect quality of life. The social consequences are measured both quantitatively and qualitatively, with a particular focus on traffic, smoke emissions, recreation displacement, scenery management, and environmental justice.

Road Traffic

Truck volume would increase throughout the FWPP treatment period. Approximately 14,000 total truck trips are expected to result from activities under FWPP, which equals roughly 2,800 truck trips per year. The Transportation Report contains more information about the road system that would be used for hauling. Individuals who commute along the roads to be used for project activities could experience longer drive times. Longer commutes reduce quality of life due to increased stress and reduced leisure time. Individuals who live and recreate in proximity to the roads used for FWPP activities may be disturbed by increased noise and dust associated with the truck traffic. The transportation report includes more information on anticipated haul routes and temporary road systems.

Smoke Emissions and Quality of Life

Smoke emissions are inevitable under all alternatives – whether from prescribed burns or wildfire. The degree (intensity and duration) of emissions, however, are variable. With prescribed burns, burn plans are developed, which helps to minimize adverse effects to quality of life in nearby communities. The Forest Service is required to work with the Arizona Department of Environmental Quality (ADEQ) to ensure that smoke impacts to human health are avoided or minimized by timing burn treatments when good ventilation (meaning the smoke is unlikely to concentrate near population centers) is forecasted. In contrast, wildfires are by definition unplanned. The community smoke effects from wildfire can range from negligible to severe. The reduced likelihood of smoke concentration near communities and advance notice associated with prescribed burns allows individuals with acute sensitivity to smoke (e.g., asthmatics) to engage in averting behavior, which reduce the negative quality of life impacts.

Recreation Displacement

Both wildfire and prescribed burns may prevent individuals from recreating at their favorite sites within or directly adjacent to the project area. Since the project area is located in a landscape with a great diversity of recreation opportunities, it is possible and very likely that when a trailhead or recreation route is unavailable during temporary area closures during implementation, recreationists would substitute by going to a nearby accessible spot with similar recreation opportunities. The campfire closure order is not anticipated to have a noticeable effect on the socioeconomic indicators as there has been a campfire closure order within the DLH continuously since 2010.When individuals engage in substitute behavior within the local area, there is unlikely to be a decrease in visitor spending. However, individuals may get less pleasure from their alternate pursuit. As a result, consumer surplus and quality of life are reduced. The recreation analysis addresses this issue in detail.

Scenery Management
Wildfire, prescribed burns, and other treatments may adversely affect scenic areas. The 4FRI treatments would affect scenery; however, all anticipated effects are short-term. Forest visitors and nearby residents may have interrupted views during portions of the 10-year treatment period. The ability to experience scenic views is central to many individuals' visit to the forests. A change in scenery may affect both quality of life and consumer surplus. The scenery and recreation analyses address the consequences in detail.

Alternative 1: No Action

Direct & Indirect Effects

Tourism and Recreation: No changes to visitor spending or recreational activities are anticipated as a direct result of activities under Alternative 1. However, uncharacteristic wildfire could displace recreation visitors to the Coconino National Forest and other adjacent recreation sites in the area, such as the Grand Canyon National Park. In addition to the approximately 2.87 million annual visitors to the Coconino National Forest (see Table 151), Grand Canyon National Park receives approximately 4.3 million visitors (USDA 2011a, USDA 2011b, NPS 2013). Combined, these visitors support approximately 10,000 jobs in Arizona (NPS 2013). Large wildfires generate negative publicity and close roads and access to National Forest System lands, which decreases tourism. Reduced visitor spending may persist after a fire is extinguished due to the destruction of trails, campsites, and other forest or park infrastructure (Morton et al 2000, Mercer et al 2003).

Furthermore, Alternative 1 would not treat any acres on the National Forest, which would increase the probability of uncharacteristic wildfire relative to the action alternatives. Uncharacteristic wildfire in the Dry Hills area has the potential to cause downstream flooding, which would affect the City of Flagstaff downstream commercial center and much of the region's tourist destinations, including access to Historic Route 66 and the Grand Canyon. Based on an analysis looking at the loss of revenue from potential flooding in this commercial center in downtown Flagstaff, it is possible that over a five year period there would be a loss of $15 million in retail sales alone (Arizona Rural Policy Institute 2014). Therefore, Alternative 1 may reduce recreation-related employment and income in the regional economy in the long term.

Wildfire Expenditures and Economic Efficiency: Historically, the Coconino NF has annually spent an average of $7,154,801 on wildfires. Under Alternative 1, wildfire suppression costs would, on average, increase due to fuel buildup and the expanding wildland-urban interface.

The per-acre administrative burden (cost of time and other resources) of planning, implementation, and monitoring forest suppression and wildfire mitigation activities would be highest under Alternative 1.The costs discussed in the Total Avoided Costs section above would be incurred as a result of high severity wildfire and the likely flooding that would occur post-fire.

Social Consequences: As described in the Fire and Fuels report, Alternative 1 has the most potential for high-severity fire. A fire in the Mormon Mountain area could damage the Lake Mary watershed, which provides ecosystem service values related to water provision and recreation. In addition to the direct effects of fire – smoke emissions, damage to property, destruction of forest infrastructure – a fire in this area could also produce flooding, which would further damage water supplies, recreation opportunities, private property, and human health. In addition, fuel loads are expected to increase over time, which would increase the smoke emissions from wildland fire in the project area. Higher emissions would increase health costs and decrease spending associated with tourism.

Cumulative Effects

Forest thinning activities would occur elsewhere on the Coconino National Forest in Coconino County as a result of the Four Forests Restoration Initiative (4FRI). Between 2000 and 2013, approximately 138,679 acres have been mechanically treated and 122,800 acres have been treated with prescribed fire on the Coconino NF. During this period, another 105,793 acres were treated on private, state, and other federally-managed lands in the vicinity of the project area. It is reasonable to assume foreseeable future activities under 4FRI will progress at similar rates in terms of acres treated per year.

The effect of past, present, and reasonably foreseeable treatment activities adjacent to the project area would improve forest health relative to existing conditions and thus reduce the potential for impacts to economic conditions (including recreational opportunities and tourism) from severe wildfires. Ongoing and reasonably foreseeable prescribed fire treatments would contribute to smoke emissions, which may affect the health and quality of life of individuals who live near or visit the forests. Since Alternative 1 would not result in fuels reduction treatments, it would not cause cumulative effects related to smoke emissions from prescribed fire. However, the potential for uncharacteristic wildfire and associated smoke emissions in the project area would be highest under this alternative.

In summary, other cumulative activities such as other similar forest restoration and fuels reduction projects would likely slightly counteract the economic losses from wildfire by supporting the local economy, but would otherwise not result in cumulative economic impacts under this alternative.

Effects Common to Alternatives 2 and 3

Alternatives 2 and 3 would treat approximately 8,937 acres using mechanical (cutting by both machine and by hand) thinning treatments and prescribed fire over approximately 8 to 10 years or until objectives are met. The analyses of their effects are combined as the proposed treatments are the same under both alternatives; only the harvesting methods differ. Where proposed activities differ, the effects are noted below.

Direct & Indirect Effects

Tourism and Recreation: Under Alternatives 2 and 3, approximately .00058 percent of the Coconino National Forest would be unsuitable for recreational uses at any given time. As section 4.6 of the National Visitor Use Monitoring (NVUM) surveys for the forests demonstrate, when individuals are unable to visit their preferred site, most will engage in substitute behavior that will continue to have an effect in the local economy (USFS 2011a, USFS 2011b). While important mountain biking and hiking trails in the project area may be negatively impacted, there are several other opportunities for both activities nearby, including the Fort Valley Trail system east of FR 420, Campbell Mesa, the Flagstaff Loop Trail, the Flagstaff Urban Trail System and several trails associated with Forth Tuthill County Park. Trails in the Kachina Peaks Wilderness are also nearby and available for hiking. While many of the mountain biking trails on the Flagstaff Ranger District are not “system trails,” they get regular use. Many of these trails are technically challenging and the nearest substitute for this type of recreational opportunity is on the Red Rock Ranger District in Yavapai County. Thus, there would be some displacement of technical mountain bike riding from the project area in Coconino County to Yavapai County, but this displacement would likely be of limited scope and would not be noticeable at the level of the County economy. As a result, FWPP treatments are not expected to measurably reduce the economic impact of recreation in the study area.

Wildfire Expenditures and Economic Efficiency: Under Alternatives 2 and 3, wildfire suppression costs would decrease over the 10-year project and for decades afterwards due to the removal of small-diameter trees and the reduction of dead and down material. In addition, the indirect costs associated with a wildfire (detailed in Table 158) would be avoided as a result of Alternative 2. The decrease in wildfire suppression costs would allow more Forest Service expenditures to be directed toward forest health (e.g., fire management for resource benefit) and visitor services activities.

A study of economic impact of fuels reduction activities on National Forests in Arizona found that based on the IMPLAN model, fuels reduction expenditures resulted in approximately 1 direct job for every 150 acres treated with mechanical thinning and prescribed fire treatment (Hjerpe and Kim 2008). While helicopter logging and cable logging may include more specialized equipment, higher costs, and thus more specialized employment opportunity, expected employment based on traditional fuels reduction techniques is likely to result in similar amounts of overall employment. Based on this study, alternatives may result in up to 60 direct jobs and 88 total jobs throughout project implementation.

This could make-up approximately 1/3 of forestry-related employment in the County, however, since the Coconino National Forest annually treats thousands of acres a year with forest thinning treatments, these jobs wouldn’t all be new to the economy, but more likely would displace other fuel treatment opportunities. Furthermore even if they were new jobs created and added to the economy, it would still result in less than ½ of 1 percent of employment in Coconino County.

Social Consequences: Alternatives 2 and 3 would increase truck traffic volume on Forest Service and nearby roads. Approximately 2,800 truck trips per year are expected to result from FWPP activities under Alternatives 2 and 3. The increased truck volume would increase commute times and lead to noise and dust effects. Individuals who use and live near those roads would have their quality of life adversely affected. A site-specific design feature for dust abatement would minimize this effect (see Chapter 2 for specific information on this design feature).

All of the action alternatives would decrease the likelihood of crown fire relative to existing conditions and Alternative 1. Over time, forest treatments would decrease fuel load and decrease potential smoke emissions from both planned and unplanned ignitions. The proposed activities under these alternatives would protect ecosystem services and other social values, such as water provision from the Lake Mary watershed, recreation opportunities, infrastructure, private property, and human health. The activities under these alternatives, therefore, are expected to improve quality of life in the communities within and adjacent to the project area.

As with all action alternatives, some individuals may not be able to recreate at their preferred sites during the treatment period. If these individuals engage in substitute behavior (e.g., recreating at a different site in the local area), there would be no impact to visitor spending at the County level. The exception to this might be from displaced mountain bikers; however, the economic impact of this would likely be so small as to be imperceptible at the level of the County economy. However, there are social and non-market consequences to recreation displacement. Individuals may get less fulfillment or enjoyment from recreating at an alternate site, which would adversely affect quality of life. Due to the short duration and relatively few sites that are expected to be affected, the quality of life implications of recreation displacement would be small.

Cumulative Effects

Past, present, and reasonably foreseeable forest thinning activities are described under the no action alternative. The effect of past, present, and reasonably foreseeable treatment activities in the analysis area would reduce the potential for severe wildfire effects relative to existing conditions. Alternatives 2 and 3 are not anticipated to affect the local economic impact of similar current and future restoration activities, such as 4FRI.

Ongoing and reasonably foreseeable prescribed fire treatments would contribute to smoke emissions, which may affect the health and quality of life of individuals who live near or visit the forests. The FWPP treatments and other ongoing and foreseeable treatments could increase exposure to smoke emissions, which could cause cumulative effects to health and quality of life for individuals who are sensitive to smoke. However, the cumulative effect of these treatments would be to decrease the potential for uncharacteristic wildfire, which would decrease the probability of smoke emissions associated with these events.

The 4FRI would likely result in additional treatments over the next 10 years that would cumulatively increase the amount of fuel treatments occurring in the County, and thus would (a) cumulative increase recreation opportunity displacement, and (b) cumulatively increase employment in the Forestry sector. The latter cumulative increase may result in a perceptible boost of economic activity at the County level because the county is currently limited in this economic sector by mill capacity (Hjerpe and Kim 2008). The cumulative actions of this project with 4FRI, Mahan-Landmark, and others is expected to result in cumulative increases in employment beyond the IMPLAN model results for each project because of increased capacity to harvest, manufacture and sell wood products in the coming decades.

Recreation: Other on-going and reasonably foreseeable vegetation treatments within the cumulative effects boundary, including 4FRI, the Hart Prairie Forest Health Project and the Bill Williams Mountain Restoration Project (on the Kaibab National Forest) may reduce the opportunities for substitute behavior when the preferred recreation site is unavailable. As a result, individuals may choose to stay home, which would decrease visitor spending and consumer surplus to a greater extent than estimated in the direct and indirect effects analysis.

The extent to which these two forces (vegetation treatment and recreation opportunity improvement) would balance each other is unknown. Therefore, the cumulative effects to the social and economic impacts from recreation cannot be precisely described. However, because of the anticipated displacement of recreational opportunities, FWPP and the forest treatment projects would result in a cumulative effect to recreational users of the National Forest in Coconino County.

Alternative 4: Minimal Treatment

Since this alternative would treat fewer acres than Alternative 2 or 3, the effects are similar but to a smaller degree.

Direct & Indirect Effects

Tourism and Recreation: The social and economic consequences related to recreation are similar to those described for Alternatives 2 and 3, although the reduction in treatment area would translate to smaller closure areas and potentially shorter closure periods for treatment to be completed. This is primarily due to Alternative 4 deferring treatment on steep slopes that would require specialized equipment.

Wildfire Expenditures and Economic Efficiency: Alternative 4 would treat approximately 30 percent fewer acres than Alternatives 2 and 3. As described in the Fire and Fuels report, this would result in a lesser reduction in the potential for severe wildfire over Alternatives 2 and 3, though still a great reduction than Alternative 1. This alternative would likely result in the support of up to 39 direct jobs and 57 total jobs. While helicopter logging and cable logging may include more specialized equipment, higher costs, and thus more specialized employment opportunity, expected employment based on traditional fuels reduction techniques is likely to result in similar amounts of overall employment. However, since the Coconino National Forest annually treats thousands of acres a year with forest restoration treatments, these jobs wouldn't all be new to the economy, but more likely would displace other fuel treatment opportunities.

Social Consequences: The key difference between Alternative 4 and Alternatives 2 and 3 is the reduction in treatment acres; specifically, the removal of treatment on steep slopes requiring specialized equipment. Individuals in nearby communities who oppose the use of specialized equipment due to noise and visual impacts and prescribed burning due to smoke would experience the highest quality of life under Alternative 4. However, Alternative 4 is expected to be less effective at reducing the potential for high severity wildfire and subsequent flooding. Therefore, the probability of uncharacteristic wildfire would be higher under this alternative (relative to Alternatives 2 and 3.

As with all action alternatives, some individuals may not be able to recreate at their preferred sites during the treatment period. If these individuals engage in substitute behavior (e.g., recreating at a different site in the local area), there would be no impact to visitor spending. However, there are social and non-market economic consequences to recreation displacement. Individuals may get less fulfillment or enjoyment from recreating at an alternate site, which would adversely affect quality of life and consumer surplus. Due to the short duration and relatively few sites that are expected to be affected, the quality of life implications of recreation displacement would be small.

Cumulative Effects

Past, present, and reasonably foreseeable forest thinning activities are described under the no action alternative. Cumulative effects from Alternative 4 are the same as those described under Alternatives 2 and 3, but to a slightly lesser degree as fewer acres would be treated.

Unavoidable Adverse Environmental Consequences

Unavoidable adverse impacts are associated with activities that have the potential to affect quality of life. Social consequences in this report focused on traffic, smoke emissions, recreation displacement and scenery; this analysis showed that there would not be any unavoidable adverse environmental consequences as a result of the proposed alternatives.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

The proposed Forest Plan amendments address management in MSO habitat and the use of mechanical equipment on steep (greater than 40 percent) slopes. Economic activity would not be affected by the proposed amendments, therefore, their implementation (or not) would not lead to differences in local employment or economic efficiency. Social conditions would not be affected by the proposed amendments.

Environmental Justice

Methodology

In 1994, President Clinton issued Executive Order 12898. This order directs federal agencies to focus attention on the human health and environmental conditions in minority and low-income communities. The purpose of EO 12898 is to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects on minority and low-income populations.

Environmental justice (EJ) is the fair treatment and meaningful involvement of people of all races, cultures, and incomes, with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The goal of environmental justice is for Federal agency decision-makers to identify impacts that are disproportionately high and adverse with respect to minority and low-income populations and identify alternatives that will avoid or mitigate those impacts. According to USDA DR5600-002 (USDA 1997), EJ, minority, minority population, low-income, and human health and environmental effects, are defined as follows:

Environmental Justice means that, to the greatest extent practicable and permitted by law, all populations are provided the opportunity to comment before decisions are rendered on, are allowed to share in the benefits of, are not excluded from, and are not affected in a disproportionately high and adverse manner by, government programs and activities affecting human health or the environment.

Minority means a person who is a member of the following population groups: American Indian or Alaskan Native; Asian or Pacific Islander; Black, not of Hispanic origin; or Hispanic.

Minority Population means any readily identifiable group of minority persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who will be similarly affected by USDA programs or activities.

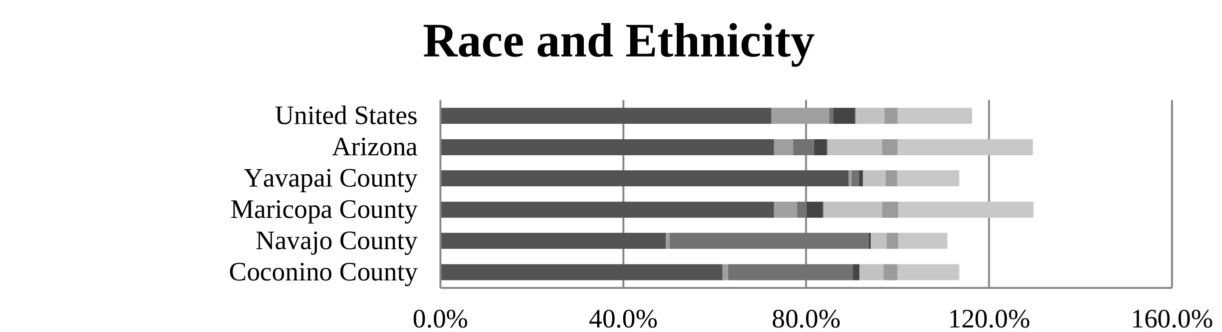
Low-Income Population means any readily identifiable group of low-income persons who live in geographic proximity to, and, if circumstances warrant, migrant farm workers and other geographically dispersed/transient persons who will be similarly affected by USDA programs or activities. Low-income populations may be identified using data collected, maintained and analyzed by an agency or from analytical tools such as the annual statistical poverty thresholds from the Bureau of the Census' Current Population Reports, Series P-60 on Income and Poverty.

Human Health and/or Environmental Effects as used in this Departmental Regulation include interrelated social and economic effects.

The emphasis of environmental justice is on health effects and/or the benefits of a healthy environment. The CEQ has interpreted health effects with a broad definition: "Such effects may include ecological, cultural, human health, economic or social impacts on minority communities, low-income communities or Indian Tribes …when those impacts are interrelated to impacts on the natural or physical environment" (CEQ 1997).

Affected Environment

According to the U.S. Census Bureau (2010) data reported in Figure 95, Coconino County differs substantially in its racial and ethnic composition compared to adjacent Arizona counties, the state and the nation.



	Coconino County	Navajo County	Maricopa County	Yavapai County	Arizona	United States
White	61.7%	49.3%	73.0%	89.3%	73.0%	72.4%
Black or African American	1.2%	0.9%	5.0%	0.6%	4.1%	12.6%
American Indian and Alaska Native	27.3%	43.4%	2.1%	1.7%	4.6%	0.9%
Asian	1.4%	0.5%	3.5%	0.8%	2.8%	4.8%
Native Hawaiian and Other Pacific Islander	0.1%	0.1%	0.2%	0.1%	0.2%	0.2%
Some Other Race	5.2%	3.4%	12.8%	4.9%	11.9%	6.2%
Two or More Races	3.1%	2.5%	3.5%	2.5%	3.4%	2.9%
Hispanic or Latino (of any race)	13.5%	10.8%	29.6%	13.6%	29.6%	16.3%

Figure 95: Race and Ethnicity

Source: U.S. Census Bureau 2010, Table DP-1

Coconino County has high concentrations of American Indian residents, due to the presence of five reservations within the county (approximately 39 percent of the County land area). Maricopa and Yavapai counties also contain Indian reservations; however, their concentrations of American Indian residents are small relative to Coconino County, Navajo County, and Arizona.[42] Maricopa

[42] Coconino County contains all or part of the Navajo Indian Reservation, Hualapai Indian Reservation, Hopi Indian Reservation, Havasupai Indian Reservation, and Kaibab Indian

County has the highest proportion of Hispanic/Latino residents out of the counties discussed in Figure 95, although it is equivalent to Arizona's proportion (29.6 percent). In contrast, Yavapai County is less diverse than both the state and nation. Approximately 90 percent of Yavapai County residents self-identify as white. As a result, environmental justice issues are more likely to occur in Coconino County than Yavapai County. However, a finding of low racial/ethnic diversity does not eliminate the need to consider potential disproportionate impacts of Forest Service management actions. A county may have a low overall concentration of minority residents, but still have areas with a high concentration of minority residents who could be adversely affected by management actions.

Table 159 reports the percentage of residents living in poverty. Maricopa and Yavapai counties have poverty rates similar to the state. Coconino County has approximately one-quarter of county residents living in poverty.

Table 159: Percent of Persons Living in Poverty

	Poverty Rate (%)
Coconino County	25.9
Arizona	17.4
United States	15.3

Source: U.S. Census Bureau 2010, Table DP03

The incidence of poverty in Coconino County is not evenly distributed among racial and ethnic groups. Approximately 50 percent of American Indian residents in Coconino County live in poverty (U.S. Census Bureau 2000). The high proportion of American Indian residents therefore increases the poverty rate relative to the state and the nation.

Based on the minority status and poverty data presented above, Coconino County appears at risk for environmental justice issues. The largest minority group – American Indians – also experience a very high poverty rate. The conditions described in this section underscore the importance of evaluating environmental justice consequences.

The air quality analysis finds that Flagstaff is a smoke sensitive area within proximity to the proposed treatments. The communities of Flagstaff and Mormon Lake are expected to be affected by the proposed prescribed fire treatments. Flagstaff and Mormon Lake all have lower concentrations of minority residents and lower poverty rates than the county as a whole (U.S. Census Bureau 2000). Therefore, the potentially disproportionate effect of smoke emissions on these communities is not an environmental justice issue. However, the implications of smoke emissions on FWPP- area communities are addressed and disclosed in the air quality analysis.

Reservation.

Navajo County contains part of the Navajo Indian Reservation, Hopi Indian Reservation, and Fort Apache Indian Reservation.

Maricopa County contains all or part of the Fort McDowell Yavapai Nation, the Gila River Indian Community, and the Salt River-Pima Indian Community.

Yavapai County contains all or part of the Yavapai-Prescott Indian Reservation, the Yavapai-Apache Nation Indian Reservation, the Hualapai Indian Reservation, and the Camp Verde Indian Reservation.

Environmental Effects

Summary of Effects

The goal of environmental justice is for agency decision-makers to identify impacts that are disproportionately high and adverse with respect to minority and low-income populations and identify alternatives that will avoid or mitigate those impacts. None of the alternatives would reduce employment and income relative to current conditions, therefore, no disproportionate adverse economic effects would occur.

Smoke emissions resulting from wildfires and prescribed burns can have health and quality of life consequences. Smoke is most likely to affect vulnerable populations – children, the elderly, and individuals in poor health. Limited communications technology, language barriers, and cultural differences may also limit the effectiveness of informing nearby residents of upcoming prescribed burns. These conditions are true under all alternatives – including the no action alternative. No alternative eliminates fire on the forests - smoke from wildfires and prescribed fires would occur regardless of chosen alternative. This project would result in no disproportionate impact from smoke to low-income or minority populations in Coconino County. Additional detail on smoke emissions is contained in the alternative-specific description of environmental consequences.

Traditional and sacred forest uses would continue under all alternatives. The heritage report discusses anticipated effects to traditional cultural properties and archaeological sites.

Alternative 1: No Action

Direct & Indirect Effects

The communities that surround the FWPP area (e.g. in Coconino County) have large minority populations, a relatively high population, and individuals vulnerable to smoke. None of the alternatives eliminate smoke – either from wildfire or prescribed burns. Alternative 1 would not result in any treatment; it would also do the least to restore a fire-adapted forest. As a result, high smoke concentrations from uncharacteristic wildfire is most likely to occur under this alternative at some time in the future. Smoke emissions from prescribed burning would not occur from Alternative 1. Smoke emissions resulting from wildfires and prescribed burns may produce health and quality of life consequences. Smoke is most likely to affect vulnerable populations – children, the elderly, and individuals in poor health.

Effects Common to Alternatives 2 and 3

Direct & Indirect Effects

Alternatives 2 and 3 would not reduce employment and income relative to current conditions and the community smoke effects are not expected to disproportionately adversely affect low income or minority populations. Tribal areas in the Colorado River, Little Colorado River, and Verde River airsheds are unlikely to experience air quality effects due to the distance from the project area. In addition, burn plans written for implementation of the proposed prescribed fires would include modeling to determine the most appropriate conditions under which to burn in order to minimize smoke impacts.

Alternative 4: Minimal Treatment

Since this alternative would treat fewer acres than Alternative 2 or 3, the effects are similar but to a smaller degree.

Direct & Indirect Effects

Alternative 4 would not reduce employment and income relative to current conditions. The economic impacts associated with FWPP are not expected to an effect on employment and income in minority and low income communities.

Alternative 4 would treat the fewest acres, which would reduce smoke emissions related to prescribed burns. However, Alternative 4 would also be less effective than the other action alternatives in terms of reducing the risk and hazard of uncharacteristic wildfire. Therefore, wildfire smoke is more likely under Alternative 4 (and Alternative 1). Tribal areas in the Colorado River, Little Colorado River, and Verde River airsheds are likely to experience air quality effects. Elders are more likely to experience acute effects. Technological and cultural constraints to effective communication would make smoke effects more pronounced, as averting behavior is limited. However, burn plans written for implementation of the proposed prescribed fires would include modeling to determine the most appropriate conditions under which to burn in order to minimize smoke impacts. Since wildfire is unplanned, the potential for severe effects to human health and quality of life are higher during wildfire events.

Unavoidable Adverse Environmental Consequences

Unavoidable adverse impacts are associated with activities that have the potential to affect quality of life. Social consequences in this report focused on traffic, smoke emissions, recreation displacement and scenery; this analysis showed that there would not be any unavoidable adverse environmental consequences as a result of the proposed alternatives

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

Social conditions would not be affected by the proposed amendments. Since no social or economic effects would result from the implementation of the proposed amendments, low income and minority populations would not be disproportionately affected.

Invasive Plant Species

Methodology

The Noxious or Invasive Weed list for Coconino, Kaibab, and Prescott National Forests was reviewed for this project. Data sources used in preparation of this report include survey data and reports collected by District and Supervisor's Office crews in past field seasons. Additional resources include forest weed files and past survey documents.

Data Sources

- Noxious or invasive weed species survey, inventory, and treatment data from NRIS database
- Forest Plan, 1987, as amended

- Final Environmental Impact Statement for the Integrated Treatment of Noxious or Invasive Weeds for Coconino, Kaibab, and Prescott National Forest (USDA FS 2005); also rreferred to as Weeds FEIS.

Incomplete and Unavailable Information

On the Forest, surveys for noxious or invasive weeds are typically conducted on a project-by-project basis. No such survey effort has occurred specifically for FWPP at this time; however previous surveys conducted for other similar fuels reduction and forest health projects has occurred within and adjacent to the project area (see Existing Conditions). Before the beginning of project-related ground-disturbing activities, an inventory of noxious or invasive weeds would occur in project operating areas, along access routes and in areas immediately adjacent to the project area. Existing infestations would be prioritized for treatment or avoided during project implementation.

Affected Environment

Existing Conditions

Noxious or invasive weeds can alter ecosystem processes, species composition, species richness, biodiversity, hydrologic functions and soil characteristics (Harrod, 2001). Noxious or invasive weeds can also affect structure and function of native ecosystems and can affect factors such as fire interval and intensity, and successional pathways.

Information about populations of noxious and invasive plant species inside and adjacent to the project boundaries and areas adjacent are from survey efforts related to other projects that occurred between 2004 and 2012 (Table 160). Infestations during previous survey efforts ranged from a few scattered plants to more dense populations.

Figure 96 and Figure 97 depict known locations of noxious or invasive weed populations in and adjacent to the DLH and MM areas. Species known to be present are described in detail below.

Table 160: Noxious or invasive weed species detected in or adjacent to DLH and MM

Common Name	Species[1]	Species Rank	Objectives	Documented Locations
Leafy spurge	*Euphorbia esula*	1	Eradicate	In vicinity of Mormon Mountain project area
Musk thistle	*Caruus nutans*	8	Eradicate	Adjacent to Dry Lake Hills project area

Common Name	Species[1]	Species Rank	Objectives	Documented Locations
Diffuse knapweed	*Centaurea diffusa*	9	Contain/Control	Within and adjacent to Dry Lake Hills project area
Scotch thistle	*Onopordum acanthium*	11	Eradicate/Control	Adjacent to Dry Lake Hills project area
Dalmatian toadflax	*Linaria dalmatica*	18	Contain/Control	Within Dry Lake Hills and adjacent to both project areas
Bull thistle	*Cirsium vulgare*	20	Contain/Control	Adjacent to Dry Lake Hills project area
Cheatgrass	*Bromus tectorum*	22	Contain/Control specific populations	Adjacent to Dry Lake Hills project area

[1]Each species is rated by the perceived severity and risk to Forest resources and is based on invasiveness and the predicted success of control measures of each species as analyzed in the Weed FEIS. The ratings were taken from the FEIS.

Figure 96: Known locations of noxious and invasive weed species in and adjacent to the DLH area

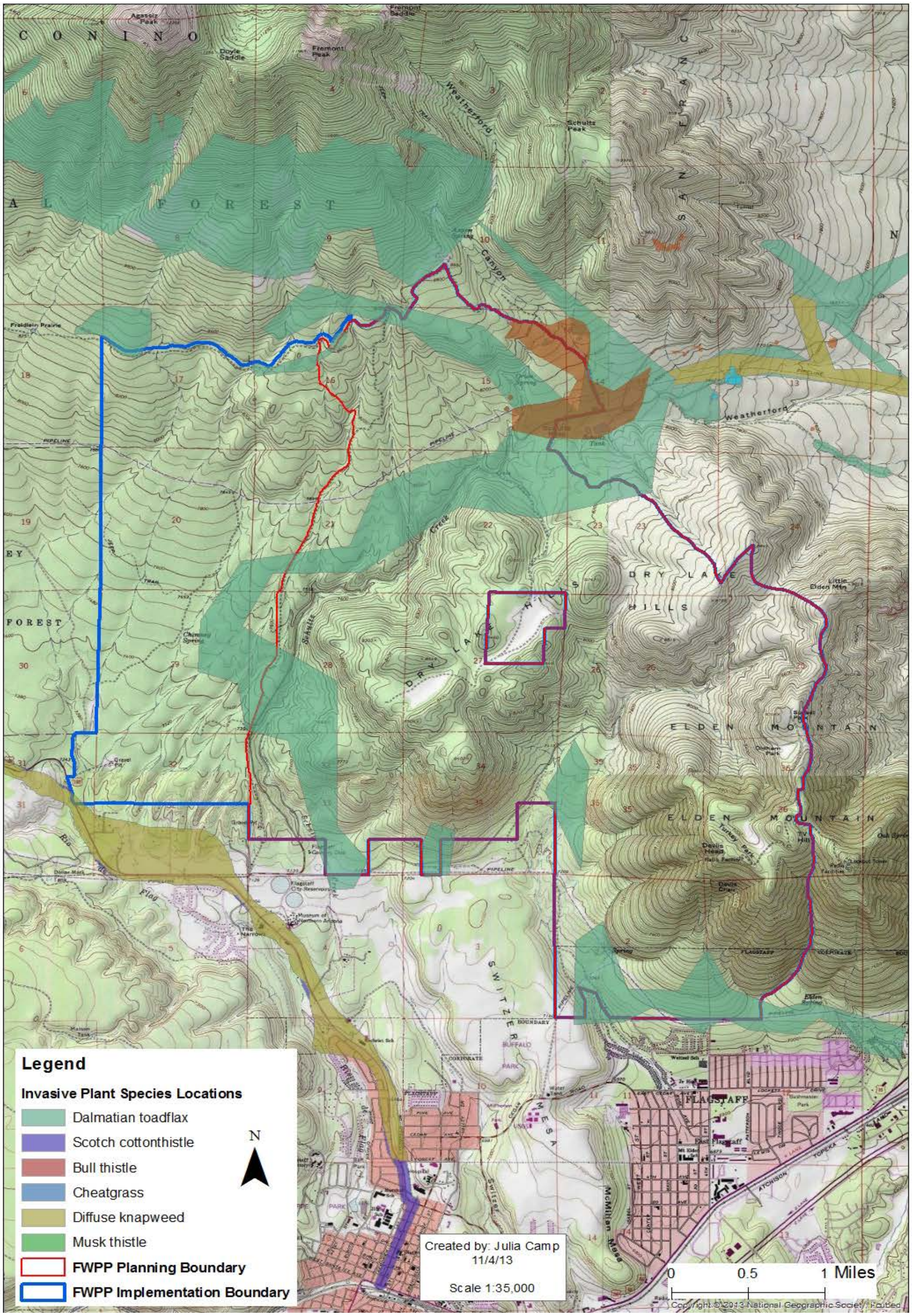
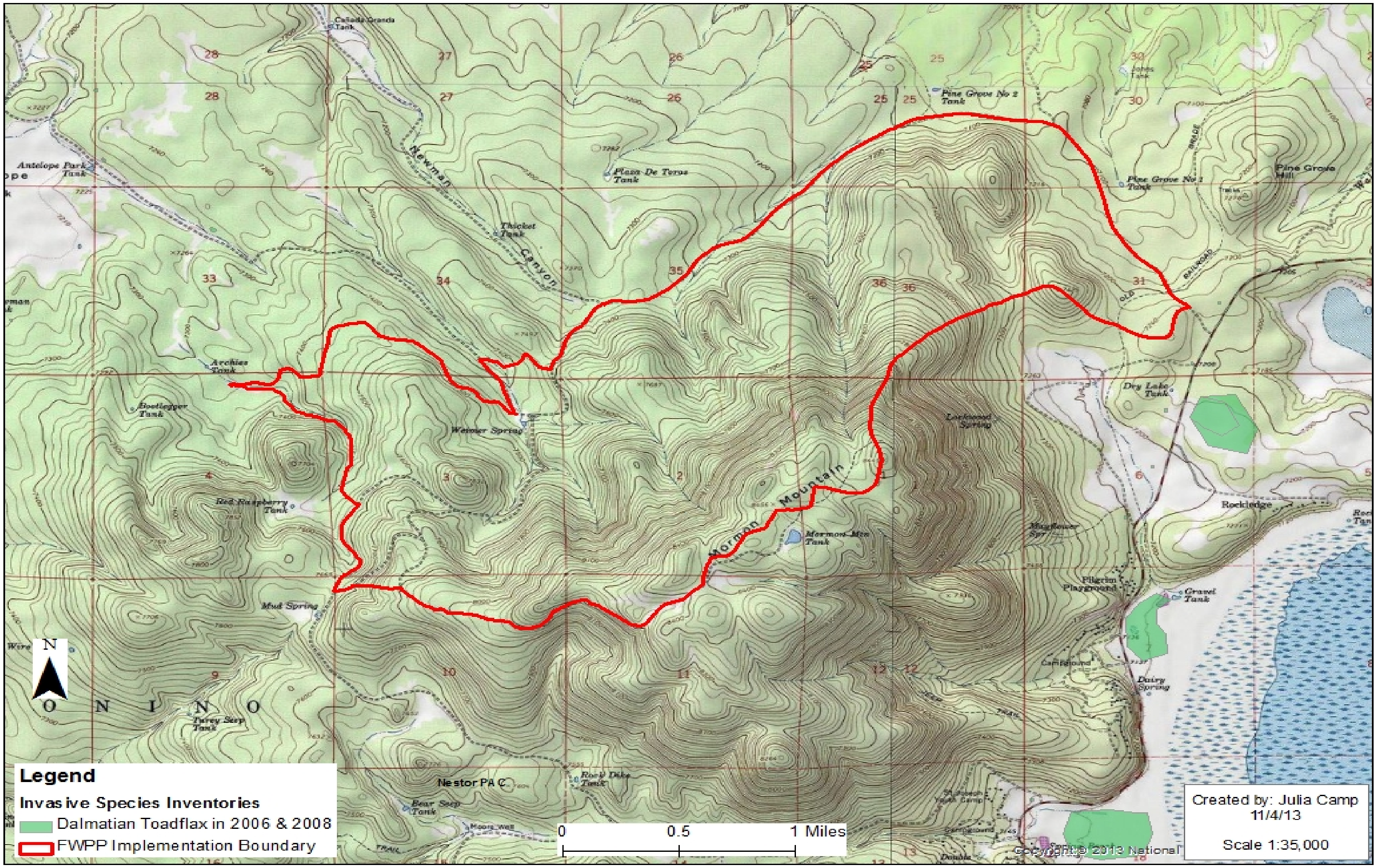

Legend
Invasive Plant Species Locations
Dalmatian toadflax
Scotch cottonthistle
Bull thistle
Cheatgrass
Diffuse knapweed
Musk thistle
FWPP Planning Boundary
FWPP Implementation Boundary
N
Created by: Julia Camp
11/4/13
Scale 1:35,000
0
0.5
1 Miles
DRY LAKE HILLS
ELDEN MOUNTAIN
FLAGSTAFF

Figure 97: Known locations of noxious and invasive weed species in and adjacent to MM area



Leafy spurge (*Euphorbia esula*)

Leafy spurge is an insidious weed from Eurasia that is very difficult to control. Roots of this species form extensive underground systems that can extend over 30 feet into the soil, and laterally as well. Seeds, forcefully expelled, can travel up to 15 feet from the original plant. The milky latex found in leafy spurge causes lesions around the eyes and mouth when eaten by cattle and some wildlife species. Largely, this species is confined to Brolliar Park, which is approximately 8 miles south of the Mormon Mountain project area, but in 2013, a small but dense population of leafy spurge was incidentally found just south of Forest Road (FR) 90 and the community of Mormon Lake. Since this species is the highest ranked noxious and invasive weed species on the Forest and FR 90 and MM have not been surveyed for it, leafy spurge will be considered in the effects analysis for this proposed project in the MM area.

Musk thistle (*Carduus nutans*)

Musk thistle (also known as nodding plumeless thistle) is a biennial that is found mainly in disturbed soils growing on roadsides, pastures, and forestlands. If not promptly controlled, this species can quickly form a monoculture, out-competing native vegetation. Populations have been reported in various locations in and around Flagstaff including along Highway 180 north of town to the Forest boundary. In the DLH area, two small populations were found in 2004 north of FR 420, near Orion Spring.

Diffuse knapweed (*Centaurea diffusa*)

Diffuse knapweed is an annual or short lived perennial and typically invades roadsides and rangelands. This plant is allelopathic, meaning it has the ability to release chemicals into the soil which inhibit the growth of other species in the immediate area. A highly competitive plant, diffuse knapweed can exclude desirable species reducing ground cover and increasing soil erosion. Populations have been located throughout the Flagstaff area. This species has not been documented in the FWPP area but has been found along Highway 180 from the Flagstaff to the Forest boundary and northeast of the DLH area along FR 420 and 743.

Scotch thistle (*Onopordum acanthium*)

Scotch thistle is a large biennial thistle, native of Europe and eastern Asia. Characteristics of this species include broad, spiny stems with vertical ribs, large, spiny leaves with dense hairs, and violet to reddish flower heads. Scotch thistle grows in disturbed habitats and waste areas and reproduces solely from seed. Seeds are equipped with structures known as pappi, which allow the seeds to disperse on wind currents. Scotch thistle has not been documented in either project area but has been found along Highway 180 between Flagstaff and the Forest boundary.

Dalmatian toadflax (*Linaria dalmatica*)

Dalmatian toadflax is a perennial forb that reproduces from both seeds and underground root stalks. Dalmatian toadflax populations may not be observed for many years but will re-establish through existing seed bank and root stalks. Due to the reproductive advantage and aggressive nature, this plant has the potential to exclude native vegetation. Dalmatian toadflax is widespread in the ponderosa pine forest type across the Forest. Numerous small infestations have been documented in the DLH area and areas adjacent to both project areas, often limited to a few plants scattered over large areas.

Bull thistle (*Cirsium vulgare*)

Bull thistle is a biennial thistle that regenerates from short-lived seed. This plant invades slash piles, old log decks, roadsides, pastures, and other disturbed sites. Bull thistle is found throughout the Coconino National Forest, mainly in the ponderosa pine type. Numerous small infestations have been recorded adjacent to the DLH area; these are mainly limited to roadsides, past timber harvest areas, and old burns.

Cheatgrass (*Bromus tectorum*)

Cheatgrass is a winter or spring annual grass widely distributed throughout North America and is common in disturbed sites. If a population becomes dense enough and large enough it can change the fire regime of an ecosystem. No populations have been documented in either project area, but cheatgrass has been found near the junction of FRs 420 and 555 just outside the DLH area boundary.

Desired Conditions

In the FWPP boundaries, desired conditions for noxious or invasive weed species are to prevent the introduction and establishment of new populations and to control and contain current populations. Use of best management practices (BMPs) as outlined in Appendix B of the Weeds FEIS would help prevent the introduction of new populations and the spread of existing populations.

Environmental Effects

Assumptions

This analysis is based on the following assumptions**:**

- The design features would be incorporated into project design and implementation
- All treatments would occur as analyzed in the various specialists reports
- Areas to be treated would be for surveyed noxious or invasive weeds before treatments are implemented
- These factors should be considered when identifying survey needs:
    - Likelihood of any of the species addressed in this document occurring within the treatment area
    - Amount of disturbance. For example, surveys may not be needed in areas scheduled for prescribed burning if the treatments are scheduled to be of low intensity.
- The larger the acreage of potential ground disturbance, the greater the area that would need to be surveyed and treated for noxious and invasive weed species prior to and after treatments.

Spatial and Temporal Context for Effects Analysis

The definitions of short-term and long-term effects for this analysis are the same as those used for soils in the Soil and Water Resources analysis: short-term effects are those that last 5 years or less and long-term are those that last longer than 5 years (see the Soil and Water Resources section and/or report for more details). Similarly, the cumulative effects boundary for this analysis is the planning boundaries of both project areas and the timeframe for projects included in the cumulative effects analysis is 15 years. This includes 5 years prior to the start of the project and 10 years afterward to include implementation and 5 years post-implementation.

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

Activities in the project areas that are likely to cause ground disturbance and therefore contribute to cumulative impacts to noxious or invasive weeds include vegetation management and recreation activities. The potential effects of the following activities were considered in the cumulative effects analysis:

- Vegetation management projects including Four Forest Restoration Initiative (4FRI) and Eastside and Jack Smith Schultz Fuels Reduction projects
- Wildfire and related suppression activities
- Livestock and wild ungulate grazing
- Travel Management Rule (TMR)
- Mount Elden/Dry Lake Hills Recreation Planning Project
- Lands projects including Mormon Mountain communication tower maintenance and Arizona Power Service (APS) transmission line construction
- Climate change
- General recreation activities such as dispersed camping, hiking, biking, and hunting

Alternative 1: No Action

Direct & Indirect Effects

There would be no direct effects to noxious or invasive weeds from project-related activities as result of the FWPP as no actions would occur under this alternative.

Under this alternative, factors that contribute to fire hazard ratings such as high canopy cover, high stocking rates and fuel build up from down and dead logs would not be reduced. The potential for wildfire transitioning to crown fires would continue to increase in portions of the project area. Severe wildfires often result in complete removal of tree canopy, complete loss of ground cover and understory plant community and alteration of soil structure and nutrients. These conditions provide potential sites for noxious or invasive weed establishment through creation of bare soil, increased light, and absence of competition from desirable native plant species. Therefore, the increased hazard of severe wildfire would continue to increase the risk of noxious or invasive weeds establishing in both project areas.

Wildfire, fires suppression activities, and the alteration of the fire regime have affected all vegetation through an increase in canopy cover, a decrease in density of understory vegetation, decrease in species composition of understory vegetation, and a decrease in ground cover of understory vegetation. Hydrologic function has also been altered due to past land management. Fire suppression has increased the potential and severity of wildfires across the landscape and increased the risk of soil disturbance, loss of the native plant community and alteration of habitat from wildfire and suppression activities. As a result, the healthy resilient plant community that would be present in many areas is absent and there are fewer desirable understory species present to provide competition that would help reduce the potential invasion from noxious or invasive weeds. Additionally, humans and equipment involved in fire suppression activities can disperse noxious or invasive weed propagules into unaffected areas through attachment of seeds and contaminated soils to boots and tires.

Cumulative Effects

The following is an analysis of the potential cumulative effects from past, present/on-going, and reasonably foreseeable future projects on the abundance and distribution of noxious or invasive weeds in the project areas. These include vegetation treatments, fire suppression, recreation uses, grazing, restoration work, TMR, climate change and lands projects such as power lines and communication towers.

Livestock grazing can affect noxious or invasive weeds through soil disturbance, trampling, consumption of desirable plants that could provide competition for noxious or invasive weeds, and possible introduction of propagules by cattle as seeds and contaminated soil can be transported on their hooves and coats. Seeds can also be transported through the feces of cattle. Potential effects of livestock grazing past, present, and future, are limited to the MM area as no grazing has occurred in the DLH for approximately 17 years and the allotment has been permanently deferred from grazing per the 2010 Peaks Allotment Decision Notice.

Grazing and browsing by wild ungulates including elk and deer has occurred across both project areas. Similar effects to those describe for livestock would be expected to occur. It should be noted that the numbers of these animals is under the control of the AZGFD, not the Forest Service.

There are past, on-going, and reasonably foreseeable future vegetation management projects in in both project areas. In DLH, past and on-going activities include Fort Valley Experiment Forest and Eastside and Jack Smith Schultz Fuels Reduction projects. On MM, past and on-going projects include removal of vegetation and associated ground disturbance for maintenance of the MM communication site and construction of the APS Mormon Mountain line. The one proposed vegetation management project in both areas is 4FRI, which is currently undergoing the NEPA process, and includes vegetation treatments and restoration activities. Mechanized, ground-based thinning and prescribed fire treatments as a result of these projects would cause disturbances to soils and loss of native vegetative cover that can result in the spread of noxious and invasive weeds. These effects are expected to be minimal since similar design features as proposed for the action alternatives for this project would be implemented, minimizing the amount of disturbance to soils and potential spread of weeds. The reduction in hazardous fuels from these projects would also reduce the likelihood of an uncharacteristic wildfire and the resulting effects to noxious or invasive weeds.

Cumulative effects from human activities such as dispersed recreation, hiking, biking, horseback riding, hunting, and fire-wood gathering have occurred and will continue to occur in both the project areas. Effects of these activities include ground disturbance and possible dispersal of noxious or invasive weeds into or across the project area. Effects would be expected to occur in small areas scattered across the project areas. As a result, their contribution to cumulative effects would be expected to be insignificant.

The TMR Record of Decision was signed September 28, 2011. The cumulative effects to this project could be both positive and negative. The TMR decision resulted in a reduction in the numbers of motorized routes open to the public and the elimination of cross country travel. This decreases the effects of motor vehicles, including crushing of native plants, creating areas of bare soil, transporting weed propagules and increasing the risk of noxious or invasive weeds establishing in the area. Another action that could occur is the decommissioning and obliteration of non-system roads through additional NEPA analyses in accordance with the TMR-designated road system. Such roads would require disturbing activities to help return the road corridor to pre-road conditions. Ground disturbing activity may contribute to the spread of weeds by eliminating competition from existing vegetation and creating bare ground that can be easily invaded than in undisturbed sites. Design features similar to those for the action alternatives for the Flagstaff Watershed Protection Project would be implemented during these activities, so cumulative effects from TMR would be minimal.

The proposed Mt. Elden – Dry Lake Hills Recreation Planning Project would address the increasing demand for recreational opportunities in the Flagstaff area. It will look at creating new or re-locating existing trails; consolidating, re-locating, or expanding existing trailheads; constructing a hang glider launch pad; and establishing new trailheads with associated parking areas either within or immediately adjacent to the FWPP analysis area. In addition to the potential effects of users of these trails, ground-disturbing activities related to this project could promote the introduction or spread of noxious or invasive weeds across the Dry Lake Hills adding to the effects of the Flagstaff Watershed Protection Project. As discussed for vegetation treatments and TMR, design features would be incorporate into the planning and implementation of the project, reducing potential additive effects.

Disturbance is a major factor in noxious weed invasions. Global climate change is expected to be a source of widespread disturbances. Higher temperatures would occur and precipitation cycles would be modified from current patterns over large areas. The warmer climate conditions may affect ecosystems by altering biotic and abiotic factors and increase the extent and severity of disturbances for some species (Bradley, et al 2010; Hellmann, et al 2008; Middleton, 2006). Larger and more frequent fires are expected (Marlon et al. 2009). Climate may favor the spread of invasive exotic grasses into arid lands where the native vegetation is too sparse to carry a fire. When these areas burn, they typically convert to non-native monocultures and the native vegetation is lost (USFS 2010).

Effects Common to Alternatives 2, 3, and 4

Direct & Indirect Effects

All three action alternatives include burn only treatments, hand thinning treatments, and mechanized thinning treatments on slopes less than 40 percent. Prescribed burning would also be performed after various thinning treatments. This section describes the potential effects of these activities on noxious or invasive weeds in FWPP.

Direct effects of management activities include ground-disturbing activities that have the potential to increase the acreage and/or density of the existing infestations within the project area. Disturbance may contribute to the spread of weeds by eliminating competition from existing vegetation and creating bare ground that can be more easily invaded than in undisturbed areas. The level of disturbance is important. Severe disturbance removes competitive vegetation, alters nutrient composition, and creates bare soil, increasing the potential for invasion or spread of noxious or invasive weeds. Management activities that would create localized severe disturbances include pile burn sites, log decks, bare soil created through road construction and decommissioning, and tire tracks created by machinery during mechanical thinning (see Soils & Water Resources section for more detail). Other management activities, such as broadcast burning and hand thinning, would also be sources of disturbance but levels would be minimal.

The majority of the analysis area (approximately 55 percent for Alternatives 2 and 3 and 50 percent for Alternative 4) would be treated by mechanized, ground-based harvesting and yarding methods on slopes less than 40 percent. Ground-based harvesting involves the use of either wheeled or tracked machinery in contact with the ground surface to both cut trees and remove them from the harvest area to landings in a process called yarding (see the Harvest Systems/Methods Descriptions in Chapter 2 for more details). This method of harvesting causes soil disturbance along a network of temporary roads, skid trails, and landings needed to accomplish thinning, increasing the risk of invasion and spread of noxious or invasive weeds.

Treatments that reduce the tree canopy and lower the stand density would indirectly impact understory plants, including noxious or invasive weeds, by increasing sunlight and available nutrients and temporarily decreasing competition between and amongst tree species. Such favorable conditions for noxious or invasive weeds could increase the size and density of existing populations in areas where weed infestations already exist and susceptibility of invasion into new areas. These effects would be minimized by incorporating thedesign features described in Chapter 2 and in the Invasive Plant Species Specialist Report, such as survey and treatment of weeds prior to project implementation.

A minor amount of hand thinning using chainsaws and hand piling of downed material would be implemented in the various action alternatives. Hand thinning would result in minimal impacts to soils since no construction of temporary roads would be needed and no equipment would be used removal or transport of materials. As a result, soil disturbance and potential impacts to noxious or invasive weeds would be negligible.

As described in the Soil and Water Resources section, the road system needed to conduct logging operations has been identified as the largest contributor to bare mineral soil of a harvest operation (Megahan and King, 1972). Temporary roads are constructed during timber harvesting to facilitate access to timber stands and are rehabilitated after treatment by restoring the roadbed to its pre-disturbance condition to the extent possible. Some of the proposed temporary roads in the FWPP would be constructed on existing road prisms that were previously Forest Service system roads.

Potential direct and indirect effects of temporary road construction, road maintenance or obliteration include disturbance and increased risks of dispersal of existing weed species and populations and introduction of new species. The density of noxious or invasive weeds tends to be greater along roadways than in interior areas with fewer disturbances (Fowler et al, 2008). These potential impacts can be mitigated by following the design features described in Chapter 2 and in the Invasive Plant Species Specialist Report. Roads that would be obliterated as part of FWPP would be complementary to the goals of TMR.

Burning is a disturbance that can release nutrients, reduce plant competition, increase the amount of available sunlight and increase bare soil. Prescribed burning may have direct and indirect effects to on all understory vegetation depending on fire severity, including existing noxious or invasive weed populations within the project area. In the FWPP, most prescribed burning would be of low severity with low soil heating, retention of most ground litter and little or no change in mineral soil and therefore minimal effects on the abundance of noxious or invasive weeds (Fowler et al, 2008; Collins et al, 2007). In some areas, moderate to high severity fire may occur during a prescribed burn, resulting in similar effects to those described for pile burning or wildfires (McGlone and Egan, 2009).

Pile burning would create localized severely burned areas. Potential consequences include the reduction or loss of the seed bank on these sites (Korb, 2001); death or reduction of soil organisms on the pile sites (Raison, 1979; Ballard, 2000; Korb et al., 2004) and development of hydrophobic soil (Kaye and Hart, 1998; Ballard, 2000). Pile sites are more prone to invasion from noxious or invasive weeds than surrounding areas and may contribute to the persistence and spread of noxious or invasive weeds in treated areas. Pile burning sites would constitute a very small portion of the project area (i.e., less than 5 percent). To minimize these effects, previously disturbed areas including old pile sites or previously used decking areas would be used where available instead of creating new sites within the project area. Additionally, pile sites would be monitored after burning occurs to identify and treat any weed infestations. Management actions can be mitigated by following the BMPs described in Appendix B of the Weed FEIS and Chapter 2 of this document.

Cumulative Effects

Cumulative effects as described under the no action alternative would be combined with direct/indirect effects to noxious or invasive weeds for all alternatives as described above. Effects of all the activities in the project areas could result in short-term increases in the abundance and density of noxious or invasive species immediately following ground-disturbing activities. However, with the distribution of ground-disturbing activities across the project areas at different times and the implementation of design features to minimize effects, these impacts would be insignificant. Additionally, by reducing the wildfire hazard and related suppression activities and treating existing infestations in the project areas prior to project implementation, long-term effects of these activities would likely result in a decrease in the number and size of infestations and the rate of spread.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

In this section, only the differences between Alternative 2 and the other action alternatives will be discussed.

Two different methods of cable yarding are proposed under this alternative: skyline and excaliner. As described in detail in the Soil and Water Resources section, the types of ground disturbance created by cable yarding are the same as for ground-based mechanized harvesting but the magnitude of disturbance is lower for cable yarding. Knowing this, Alternative 2 would be expected to have the highest amount of soil disturbance from mechanized thinning of the three action alternatives: 1,169 acres in DLH and 106 acres in MM. Additionally, Alternative 2 requires the largest mileage of temporary roads to be created and rehabilitated: 17.61 miles in DLH and 3.6 in MM. As a result, Alternative 2 would disturb the largest area of the three action alternatives, increasing the risk for the invasion or spread of noxious or invasive weeds in the project areas. As discussed before, the risk of invasion and spread would be minimized through the design features and BMPs described in Chapter 2 and in the Invasive Plant Species Specialist Report.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

In this section, only the differences between Alternative 3 and the other action alternatives will be discussed.

There are several differences between Alternatives 2 and 3. First, no cable yarding would occur in either project area under this alternative. Instead, 973 acres in DLH would be mechanically thinned and yarding would occur by helicopter. Since helicopters would be used to transport logs to landings, there would be no need for cable corridors, resulting in a reduction in potential soil disturbance.

Another difference is thinning and yarding by specialized equipment on slopes greater than 40 percent would occur on 273 acres in DLH and on 73 acres in MM. This would be done with either multi-wheeled harvesters or track mounted levelling harvester designed for operation on steep slopes. As described in the Soil and Water Resources section, through use of BMPs, soil disturbance would be expected to be light to moderate on slopes where this equipment was used and would be similar to the level of disturbance from ground-based thinning on slopes less than 40 percent. Slash mats could be used to protect soils during implementation if exposure of bare mineral soil were to exceed 9 percent. These would protect soils from disturbance and reduce the potential impacts of noxious or invasive species in both project areas.

Implementation of these two methods would also result in a decrease in the number of temporary roads that would need to be created and rehabilitated under Alternative 3: 12.88 miles in DLH and 2.5 miles in MM.

Under Alternative 3, the decrease in acres of soil disturbance under this alternative through the use of different harvest methods and the related decrease in miles of roads created and rehabilitated would result in a decreased risk of invasion or spread of noxious or invasive weeds when compared with Alternative 2.

Alternative 4: Minimal Treatment

Under Alternative 4, treatments would occur on a smaller number of acres than under Alternatives 2 and 3: a reduction of 2,504 acres in DLH and 631 acres in MM. Additionally, there would be no treatments that involve cable or helicopter yarding or the use of specialized steep-slope equipment. While the same number of miles of temporary roads would be created and rehabilitated on MM under Alternatives 3 and 4, there would be a decrease of 1.1 miles created and rehabilitated between Alternatives 2 and 4. In DLH, there would be a decrease of 7.2 and 2.5 miles of temporary roads under Alternative 4 when compared with Alternative 2 and 3, respectively. These differences would result in the least amount of soil disturbance of the three action alternatives and therefore the lowest risk of invasion or spread of noxious or invasive weeds.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

Amendment 1 to the Forest Plan would allow mechanical treatments and hand thinning in Mexican spotted owl protected activity center treatments and prescribed burning within nest cores. The amendment would also allow removal of trees 24 inches dbh and greater in Mexican spotted owl protected or recovery habitat for cable logging corridors in order to facilitate treatments under Alternative 2. Implementation of this amendment would result in increases in the amount of soil disturbance in the project area since larger areas would be thinned and burned.

This would result in a short-term increase in the risk of invasion and spread of noxious or invasive weeds. Over the long-term, improved vegetative ground cover would occur by providing conditions conducive to the establishment of a more vigorous understory of grasses, forbs and shrubs. This improvement in the health of vegetative ground cover would reduce the potential for the effects of high severity fire while improving the ability of native plants to compete with noxious and invasive weeds. Proposed population and habitat monitoring would not increase the risk of invasion or spread of noxious or invasive weeds as soil disturbance from these activities would be very limited or not occur.

Implementation of Amendment 2 to allow mechanical harvesting on slopes greater than 40 percent within the project area would have similar impacts to those described for Amendment 1. A short-term increase in the risk of invasion and spread of noxious or invasive weeds would occur from the increase in soil disturbance on steep slopes. Over the long-term, this amendment would decrease the potential for high severity wildfire and improve the ability of native vegetation to compete with noxious or invasive weeds. This would result in a long-term decrease risk in the invasion or spread of noxious or invasive weeds.

Sensitive Plants

Methodology

This document discusses the effects of FWPP on one Region 3 sensitive plant species, Rusby milkvetch, which occurs only in the Dry Lake Hills area of the project. No Region 3 sensitive plants have been found within the operational boundary of the Mormon Mountain portion of the project.

There are no threatened or endangered plants within the project boundaries.

Data Sources

Sources of information for this report were collected from the following resources:

- Past surveys from the Jack-Smith Schultz Project.
- Surveys in the Antelope Park area near Mormon Mountain in 2011.
- Location data for *Astragalus rusbyi* from the Arizona Heritage Database and Ecological Restoration Institute, Northern Arizona University.
- Location data from the NRM TESP/Invasives database
- SEINet data.
- Forest Plan, as amended
- Various files

Affected Environment

Existing Condition

Rusby milkvetch (*Astragalus rusbyi*)

Rusby milkvetch is an upright perennial herb with pinnately compound leaves of oval leaflets. No tendrils are present on the stem. The stem can be reddish in color with dark spots along the stem. A distinguishing character is the presence of trigonus pods (triangular in cross section). Each seedpod also has a stipe, which is a narrow area at the base of the pod where it connects the plant. The flowers are white to cream color and pea-like and the plants bloom from May to September. This species is similar to the more common *Astragalus recurvus* and can be confused with it during identification. Habitats for Rusby milkvetch include aspen groves, mixed conifer, ponderosa pine/Arizona fescue, and ponderosa pine/gambel oak sites in dry or temporarily moist basaltic soils.

The range of Rusby milkvetch is limited to northern Arizona where it is mostly limited to areas north and west of the San Francisco Peaks. Some portions of the range have experienced large fires such as the Hochderffer and Horseshoe Fires in 1996, the Pumpkin Fire in 2000, the Leroux Fire in 2001, and the Schultz Fire in 2010. Surveyors detected numerous occurrences of Rusby milkvetch in the adjacent Hart Prairie Project (2010), Wing Mountain Project (2012) and the Jack-Smith/Schultz Project (2005). The Ecological Restoration Institute at Northern Arizona University has recorded numerous locations of Rusby milkvetch in several of their restoration projects, including the nearby Fort Valley and Gus Pearson Projects. Table 161 shows the locations of Rusby milkvetch within the project area and the proposed treatments under each action alternative within those areas (note: Rusby milkvetch is only known to occur in the DLH portion of this project).

Table 161. Locations and sites containing Rusby milkvetch in the Dry Lake Hills portion of the project area, with proposed treatments for each action alternative.

Common Name	Date	Location	Site	Alternative 2	Alternative 3	Alternative 4
Rusby milkvetch	7/29/2004	267	7	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction	No Treatment
Rusby milkvetch	5/28/2013	267	18	MSO Nest Fuels Reduction - Burn Only	MSO Nest Fuels Reduction - Burn Only	No Treatment
Rusby milkvetch	7/29/2004	267	37	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction	No Treatment
Rusby milkvetch	5/28/2013	267	9A	MSO PAC Fuels Reduction	MSO PAC Fuels Reduction	No Treatment
Rusby milkvetch	2/18/2009	267	15A	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction	No Treatment
Rusby milkvetch	2/18/2009	267	16B	MSO PAC Fuels Reduction	MSO PAC Fuels Reduction	No Treatment
Rusby milkvetch	2/18/2009	267	35B	MSO PAC Fuels Reduction	MSO PAC Fuels Reduction	No Treatment
Rusby milkvetch	7/29/2004	277	2	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction
Rusby	8/17/	277	13	Goshawk PFA	Goshawk PFA	Goshawk

Common Name	Date	Location	Site	Alternative 2	Alternative 3	Alternative 4
milkvetch	2005			Fuels Reduction	Fuels Reduction	PFA Fuels Reduction
Rusby milkvetch	7/29/2004	277	1B	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction
Rusby milkvetch	8/17/2005	277	36A	Goshawk PFA Fuels Reduction	Goshawk PFA Fuels Reduction	Goshawk PFA Fuels Reduction
Rusby milkvetch	5/21/2013	286	3A	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction
Rusby milkvetch	8/4/2004	286	4A	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction
Rusby milkvetch	8/4/2004	286	4B	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction	Ponderosa Pine Fuels Reduction - Hand Thin
Rusby milkvetch	7/28/2004	287	2D	MSO Nest Fuels Reduction - Hand Thin	MSO Nest Fuels Reduction - Hand Thin	MSO Nest Fuels Reduction - Hand Thin
Rusby milkvetch	7/29/2004	287	9A	Mixed Conifer Fuels Reduction	Mixed Conifer Fuels Reduction	Mixed Conifer Fuels Reduction
Rusby milkvetch	8/2/2004	287	9B	Mixed Conifer Fuels Reduction	Mixed Conifer Fuels Reduction	No Treatment

Desired Condition

The desired future condition for Rusby milkvetch is to maintain or increase the populations and potential habitat for it within the project area. Manual direction (FSM 2670.5(19)) emphasizes that management actions should avoid or minimize impacts to sensitive species. Mitigating measures should be incorporated into project design and implementation as necessary to minimize impacts to sensitive plants.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

There would be no direct or indirect effects from management actions to Rusby milkvetch because none of the activities considered in this analysis would occur. However under this alternative, the potential for high-severity wildfire would continue. Indirect effects to Rusby milkvetch could occur from such a wildfire, and include impacts from the fire itself, suppression activities (e.g. fireline construction), and potential flooding post-fire.

Cumulative Effects

The boundary for this discussion includes the range of Rusby milkvetch within the Coconino National Forest. The timeframe for this discussion is from 1999 when Rusby milkvetch was added to the Region 3 Sensitive Species list for Coconino National Forest. Effects to Rusby milkvetch before 1999 include past management actions by the U.S. Forest Service such as grazing, timber sales and prescribed burning within the project area and throughout its range. The effects of these actions are unknown but contribute to the current condition for the species and its habitat. The end point for this discussion is approximately 10 years into the future.

Cumulative effects from the No Action Alternative include the overall increased acreage on the Flagstaff Ranger District susceptible to high-severity wildfire.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Direct effects would include loss of individual plants or groups through management actions. Factors contributing to these effects would include disturbance from management actions such as activities associated with tree removal, prescribed burning, road reconstruction, maintenance and decommissioning, temporary road construction and decommissioning. Under this alternative, a series of corridors to accommodate cable logging would be established in areas with steep slopes.

Activities associated with tree removal and prescribed burning may cause some immediate losses of individuals and groups but would beneficial in the long term by reducing competition from overstocked forests, increasing the amount of available sunlight and by increasing available nutrients. In a long-term ponderosa pine ecological restoration study in the Fort Valley Experimental Forest, Rusby milkvetch was an indicator species of tree thinning and prescribed burning, showing a positive response to treatments after five years (Laughlin et al, 2008). Some individuals may be lost during prescribed burning, especially in areas where only isolated individuals occur or in areas where plants were not detected during surveys. However prescribed burning may have beneficial direct and indirect effects on all understory vegetation including Rusby milkvetch. Burning is a disturbance that can release nutrients, reduce plant competition, and increase the amount of available sunlight light.

Most prescribed burning would be of low severity. In some cases, fire severity may be higher in limited areas depending on variables such as management goals, weather, fuel conditions and topography. In these areas, there would be limited negative direct effects through deaths of scattered individuals or groups of Rusby milkvetch if they occur at that particular location. Limited loss of small groups of plants in these cases would not significantly contribute to the overall decline of populations of this species within the project area or over the range of Rusby milkvetch. The indirect effects of higher fire severity in these areas would be similar to those for slash pile burning, described below.

One of the associated activities with several treatments includes piling of slash from management activities. Slash piles may have negative direct and indirect effects on all understory vegetation including Rusby milkvetch. Slash pile construction could be a possible direct negative effect if the pile is placed in or near existing populations of Rusby milkvetch. Pile burning would create locally severely burned areas at pile sites, which is a negative indirect effect. Consequences include, but are not limited to, the reduction or loss of the seed bank on these sites (Korb, 2001); death or reduction of soil organisms on the pile sites (Raison, 1979; Ballard, 2000; Korb et al., 2004) and development of hydrophobic soil (Kaye and Hart, 1998; Ballard, 2000). Slash pile sites are more prone to invasion from noxious or invasive weeds than surrounding areas and contribute to the persistence and spread of noxious or invasive weeds in treated areas (Korb et al, 2004). Mitigation for these effects is to use previously disturbed areas including old pile sites or previously used decking areas where available instead of creating new sites within the forest.

An indirect effect of management actions within the potential habitat of Rusby milkvetch includes an increased risk of invasion from noxious or invasive weeds. These effects would be mitigated by incorporating the Best Management Practices described in Appendix B of Final Environmental Impact Statement for the Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab and Prescott National Forests (2005). Incorporation of the Best Management Practices would mitigate the effects of increased disturbance from management activities, and help to control the spread and introduction of weeds within the habitat of Rusby milkvetch. See Appendix B for noxious for invasive weed locations.

Direct and indirect effects of temporary road construction, road maintenance, road reconstruction or decommissioning include destruction of individual plants, localized disturbance of suitable habitat and the potential introduction of noxious or invasive weeds. These effects would be mitigated by surveying the areas where activities would occur as well as nearby areas that may be disturbed and by avoiding existing plant populations.

In this alternative, cable corridors would be established to facilitate removal of trees on steep slopes. Surveys for Rusby milkvetch within the project area will likely not occur on steep slopes due to concerns for safety of the survey crews. In these areas some plants may go undetected and be more vulnerable to loss from management actions. All trees would be removed in the corridors, which are approximately 12 feet wide, resulting in a heavily disturbed area of approximately 191 acres total in the Dry Lake Hills. As a result, these areas may be more prone to weed infestations. This would impact the habitat of all understory plants including Rusby milkvetch. See the weed report for more details.

The permanent campfire restriction proposed for the DLH area would help reduce the potential for human caused wildfires and would therefore reduce the threat of wildfire to understory plant communities including Rusby milkvetch.

Cumulative Effects

The boundary for this discussion includes the range of Rusby milkvetch within the Coconino National Forest. The timeframe for this discussion is from 1999 when Rusby milkvetch was added to the Region 3 Sensitive Species list for Coconino National Forest. Effects to Rusby milkvetch before 1999 include past management actions by the U.S. Forest Service such as grazing, timber sales and prescribed burning within the project area and throughout its range. The effects of these actions are unknown but contribute to the current condition for the species and its habitat. The end point for this discussion is approximately 10 years into the future.

There are occurrences of Rusby milkvetch in previously analyzed fuels reduction projects including Eastside Fuels Reduction and Forest Health Project (2006), the Jack Smith/Schultz Fuels Reduction and Forest Health Project (2008), Hart Prairie Fuels Reduction and Forest Health Project (2010), Railroad Timber Sale (2010?) and Wing Mountain Fuels Reduction and Forest Health Restoration Project (2012). The effects of those projects were similar to the effects discussed above. Findings in those projects were “may effect but not likely to adversely to adversely affect.” Mitigations for those projects have reduced the effects of these projects on Rusby milkvetch to non-significant levels.

Fire suppression and past alteration of the fire regime through suppression have affected all vegetation including Rusby milkvetch through changes in tree density and understory species composition. Elimination of fire in the project area and throughout most of the range of Rusby milkvetch has allowed tree canopy and stand density to increase in some areas, reducing the abundance or eliminating of most understory species including Rusby milkvetch. The elimination of fire has also resulted in the increase in litter in some areas which has negatively affected understory plant species by eliminating plants and by contributing to the increase in fire spread, length of residence time of fire and fire severity.

The Leroux Fire (2001) contained occurrences of Rusby milkvetch. Several of these occurrences were documented within the fire perimeter after the fire occurred. Manual, biological and chemical treatment of Dalmatian toadflax infestations have been conducted in the fire area but no adverse effects to Rusby milkvetch have been observed from these treatments.

The Schultz Fire (2010) contained several occurrences of Rusby milkvetch. Some of these plants were eliminated in the fire and the habitat in some areas was severely altered. The effects of large, high severity wildfires such as the Schultz Fire last for many years and long-term alteration of habitat occurs. In addition to the wildfire itself, severe flood damage occurred in some areas as a result of the loss of vegetation and ground cover, severely altering the habitat for Rusby milkvetch in some areas. Management actions to reduce the flooding risk to private property include seeding, mulching, road reconstruction and maintenance and channel construction and maintenance. The extent of the effects to Rusby milkvetch and its habitat are unknown. These actions were authorized in several analyses including the Inner Basin Waterline Reconstruction Project (2011), three Categorical Exclusions for reforestation, hazard tree removal, and rehabilitation work (2011), and the Schultz Sediment Reduction Project (2012).

The Radio (1977) Fire and the rehabilitation efforts for it were past activities within the range of Rusby milkvetch but are outside the timeframe of this discussion. Therefore, the effects of the fire and resulting management actions to control the fires and rehabilitate the effects are considered part of the existing condition.

In a long-term ponderosa pine ecological restoration study in the Fort Valley Experimental Forest, Rusby milkvetch was an indicator species of tree thinning and prescribed burning, showing a positive response to treatments after five years (Laughlin et al, 2008).. Drought may also affect the occurrences of Rusby milkvetch. The species may be absent from certain areas during times of prolonged lack of precipitation and then re-emerge when conditions are more favorable. Additional restoration activities in the range of Rusby milkvetch include activities for aspen restoration, Bebb’s willow restoration and springs enhancement activities that will be authorized in the first EIS decision. All of these activities are small in areal scale but may affect a few individuals of Rusby milkvetch.

Rusby milkvetch is grazed by cattle and wild herbivores and this may affect the ability to detect occurrences during certain times if plants have been recently eaten. The range of Rusby milkvetch within the project area includes only the DLH portion of the project. For the purposes of livestock grazing, this area is included in the Peaks Allotment which was analyzed for the reauthorization of cattle grazing in 2010. Portions of the Peaks Allotment that occur within the project area where not considered for reauthorization in the 2010 decision so no cattle grazing will occur in the portion of the DLH area affected by this analysis. Wild grazers may still consume Rusby milkvetch in the project area. Deer and elk may preferentially select legumes when they find them. Small animals such as rodents may also eat Rusby milkvetch. The cumulative effects of grazing include past and present loss of individual plants to grazing animals and alteration of habitat through animal impacts such as trampling and compaction.

Rusby milkvetch has been observed along the Schultz Trail, which is adjacent to the project area. Several of the locations detected by survey crews are along the trail. Trail users may impact individual plants at these locations through trampling and compaction of soil. Special use events may occasionally impact individual Rusby milkvetch plants but at a non-significant level. There are numerous user created trails in the Dry Lake Hills as well as recreational activities such as rock climbing and mountain biking. The effects of these activities on Rusby milkvetch are unknown but will be addressed in a future analysis for recreation in the Mount Elden Dry lake Hills Area.

In 2000, the Forest withdrew the San Francisco Mountain and Mount Elden areas from mineral exploration. This withdrawal could have indirect long-term beneficial effects on species such as Rusby milkvetch by preserving habitat that might otherwise be altered through mineral exploration.

A mining operation, the White Vulcan Mine altered potential habitat for Rusby milkvetch in the localized area of the mining operation. Active mining no longer occurs at the site and the mine has been rehabilitated.

The Coconino National Forest implemented the Travel Management Rule in 2011. As a result, cross-country travel was eliminated and the mileage of roads open to public travel was reduced. This resulted in the reduction of the effects from motorized travel such as crushing of plants; damage to potential habitat such damage to soils and fragmentation of habitat.

In 2005, the Forest signed a decision allowing expansion the facilities at the Arizona Snowbowl. Artificial snowmaking was part of this decision. To facilitate snowmaking, a waterline was constructed from wastewater treatment facilities in Flagstaff to the Arizona Snowbowl. During the construction of the waterline, several Rusby milkvetch plants were destroyed but the project finding of effect for the project was a “may effect but not likely to adversely affect” the existence of Rusby milkvetch.

The management actions proposed for this project would have no significant negative effects on the overall distribution and abundance within the project area or within the total range of Rusby milkvetch, provided the mitigations recommended in this document are incorporated into the project design and implementation. The management actions would not significantly contribute to the cumulative effects discussed above, provided they are mitigated as recommended. The project would have beneficial direct and indirect effects on Rusby milkvetch by reducing fire hazard and therefore the threat of severe wildfire within the potential habitat of Rusby milkvetch within the project area. Additionally, all understory plants including Rusby milkvetch would benefit from the reduction of tree density and canopy in certain areas of the project by reducing competition for nutrients, light and growing space.

Routine road maintenance within the range of Rusby milkvetch may occasionally impact Rusby milkvetch individuals but at non-significant levels.

As a result of the Schultz Fire and accompanying flooding (2010) major roads in the fire area were heavily damaged resulting in the need for major reconstruction on these roads. Some individuals of Rusby milkvetch may have been lost in these areas. The extent of the loss from management activities was likely small compared to the habitat alteration from the fire and flood.

Manual, chemical and biological control of noxious or invasive weeds in the range of Rusby milkvetch have occurred and will continue to occur. There is a slight but insignificant risk of damage or loss to individuals during the implementation of manual or chemical treatments. There is no risk to Rusby milkvetch from biological control because insects developed for biological control are species-specific. In the long-term, weed control will have beneficial effects to Rusby milkvetch by reducing competition from weeds and by improving habitat conditions.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

The effects of this alternative are similar to those for Alternative 2 except there would be no cable logging and therefore no creation of corridors. Tree removal on steep slopes would be facilitated by the use of specialized ground based equipment or by helicopters. There would be no highly disturbed areas for logging corridors such as those discussed in alternative 2. Therefore the acreage of severe disturbance would be lower for Alternative 3 than for Alternative 2.

The effects of harvesting trees using helicopters would result in less ground disturbance, but may result in larger slash piles on decking sites. If these piles are burned in place a higher level of disturbance from pile burning is possible. The scale of the effects from burning would be dependent on how much of the woody material is removed from the site. Higher utilization of harvested material and/or removal from the project area would result in lower levels of disturbance from fire as compared to the traditional method of burning all undesirable material on site.

All other effects of this alternative are the same as Alternative 2.

Cumulative Effects

The cumulative effects of this action are the same as those for Alternative 2.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

In comparison to Alternatives 2 and 3, fewer areas containing Rusby milkvetch would be treated. Many occurrences of Rusby milkvetch are in areas that would be untreated in this alternative due to steep slopes and inaccessibility. This would result in no disturbance to plants from management actions associated with tree removal in these areas. However, the risk of loss individual plants or alteration of habitat due to uncontrolled wildfire would remain higher as compared to Alternatives 2 and 3 because fuels in these areas would not be reduced.

No cable corridors would be constructed in this alternative. Therefore, the high levels of disturbance and associated impacts to Rusby milkvetch discussed in Alternative 2 above would not occur.

This alternative focuses on the area south and east of FR 420. The area above FR420 to the wilderness boundary would be treated under separate NEPA prepared for Jack-Smith/Schultz.

The effects to Rusby milkvetch in that area have already been addressed and design features have been described in the Jack-Smith/Schultz analysis.

In this alternative, more hand thinning would occur compared to Alternatives 2 and 3. Therefore the levels of disturbance in areas of hand thinning are expected to be lower, especially in areas of steep slopes that would have been treated using cable logging or specialized equipment.

In this alternative, fewer temporary roads would be built. Disturbance from road construction, maintenance and decommissioning that would occur as a result of these actions would therefore also be less when compared to Alternatives 2 and 3.

Cumulative Effects

The cumulative effects of this action are the same as those for Alternative 2.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

Amendment 1 would incorporate the most recent Recovery Plan for Mexican Spotted Owl and would allow higher levels of thinning and burning within MSO habitat than was previously authorized. This would result in more open stand conditions as compared to past treatments in similar areas. The effects would be similar to those discussed for amendment 1 including higher levels of disturbance, more open conditions and reduced competition for resources. With the removal of timing restrictions for MSO, management activities would be allowed to occur during the growing season of Rusby milkvetch making the top portions of the plant more susceptible to destruction during activities as compared to treatment within MSO PACs in the past. This could lead to destruction of the above ground biomass of individual Rusby milkvetch plants during certain growing seasons, reducing such functions as the production of seed by these individuals.

Amendment 2 would remove slope restrictions in the current Forest Plan, and would allow tree removal on slopes greater than 40 percent. Equipment such as cable logging, helicopter logging or specialized ground based equipment would be needed to accomplish the treatments. In this alternative, cable logging would occur and would result in the establishment of approximately 191 acres of heavily disturbed areas. Individual or plant groups may be destroyed in these corridors during their establishment and use. The long-term effects are unknown but would result in open, treeless areas for a prolonged period of time.

Recreation

Methodology

In addressing the recreation and wilderness conditions for the FWPP analysis area and the potential effects to these resources from the alternatives, the best available science was used, including relevant peer-reviewed literature, published reports from regulatory and land management agencies, existing resource inventories, field visits, and the professional judgment of the specialist(s). Literature and documents reviewed includes the Forest Plan, as amended and the draft revised Forest Plan.

Recreation Opportunity Spectrum

The Forest Service uses the Recreation Opportunity Spectrum (ROS) to provide a framework for defining classes of outdoor recreation environments, activities, and experience opportunities

(USDA Forest Service, ROS Primer and Field Guide 2011). The ROS is a land classification system that categorizes national forest land into six classes, each class being defined by its setting and by the probable recreation activities the setting offers. The six ROS classes are: primitive, semi-primitive non-motorized, semi-primitive motorized, rural and urban. ROS classifications within the analysis area were referenced to determine if any modifications would be necessary given the alternatives.

The ROS classifications within the FWPP analysis area include: Semi-Primitive Non-Motorized (SPNM), Semi-Primitive Motorized (SPM) and Roaded-Natural (RN). The Kachina Peaks Wilderness, located directly north of the project area is Primitive (P).

The Coconino National Forest is currently revising the Forest Plan, which could potentially change the ROS zones; however, the current draft of the revised Forest Plan does not reflect significant changes to the ROS classifications within the project area.

Affected Environment

Recreation use of the Coconino National Forest has grown rapidly over the last two decades, commensurate with the growth of the population in the southwest region. The Coconino National Forest is primarily visited for non-motorized activities such as hiking, backpacking, viewing wildlife, or viewing natural features.

In 2012 and 2013 students from Northern Arizona University, FS personnel, members of Friends of Northern Arizona, and other volunteers conducted an informal survey of forest visitors at different trailheads for the Mount Elden / Dry Lake Hills area. The purpose of the survey is to assist forest personnel with the Mount Elden / Dry Lake Hills Planning Project.

In general, the survey was designed to better understand who currently uses the area, what type of recreational activities people enjoy in the area, and what forest visitors would like to see in the future. For example, survey results identified that walking/hiking is the most common trail use activity by forest visitors on the Mount Elden / Dry Lake Hills trail system.

Recreation Activities within the Project Area

There are a number of developed recreation facilities and USFS trails within and/or adjacent to the FWPP analysis area. Also, the Kachina Peaks Wilderness is located just north of Forest Road (FR) 522 (Freidlein Prairie Road) near the northern boundary of the project area. The ROS classification within the analysis area includes Semi-Primitive Non-Motorized (SPNM), Semi-Primitive Motorized (SPM) and Roaded-Natural (RN). Additionally, the Coconino National Forest is concurrently conducting an environmental analysis of non-motorized recreation for trails, special uses and facilities known as the Mt. Elden – Dry Lake Hills Recreation Planning Project, also referred to as MEDL. Much of MEDL planning area overlaps with the Dry Lake Hills portion of the FWPP area.

The Mt. Elden/Dry Lake Hills region is one of the most popular and heavily used areas for recreational purposes on the Forest; largely because of its proximity to Flagstaff and the appealing

Figure 98: Sunset Trail – Hiker enjoying the views and scenery.

forest topography and vegetation. The trail system is highly valued by the Flagstaff trail community including organizations such as Flagstaff Biking Organization, Coconino Horseman's Alliance, Northern Arizona Trail Runners Association, Arizona Trail Association, Flagstaff Unified School District and others. The area provides thousands of forest visitors an opportunity to enjoy the great outdoors whether they are hiking, mountain biking, riding their horse, hunting, birding, dispersed camping, driving for pleasure, snowshoeing, cross-country skiing or rock climbing. Adjacent property owners walk this area on a daily basis and the project area abuts Buffalo Park, a city-owned and managed park that also serves as a primary portal into the forest from Flagstaff.

The Mt. Elden /Dry Lake Hills Trail System was dedicated in 1987. Within and/or adjacent to the analysis area there are six trailheads providing access to twelve designated USFS trails including portions of the Arizona National Scenic Trail, Flagstaff Loop Trail, and the historic Beale Wagon Trail. Currently Flagstaff Climbing operates under a special-use permit to provide guided climbing opportunities at West Elden (adjacent to Elden Lookout road – FR 557). There is a launch pad at the top of Mt. Elden in the Turkey Park area that is used by hang gliders and para-gliders. Additionally, there are many organized recreation events that have been issued special-use permits for over a decade, such as the Soulstice Mountain Trail Run sponsored by Northern Arizona Trail Runners Association.

The Mt. Elden Environmental Study Area (ESA) was established in the mid-seventies. The ESA is a 400-acre parcel of land established as a study site and a bird sanctuary. As part of the ESA, there are four designated trails that provide interpretive opportunities for students and the general public. The western portion of the Mt. Elden ESA is located within the analysis area (approximately 278 acres). The ESA is frequented by local school groups and is identified as a birding hotspot in many bird watching publications.

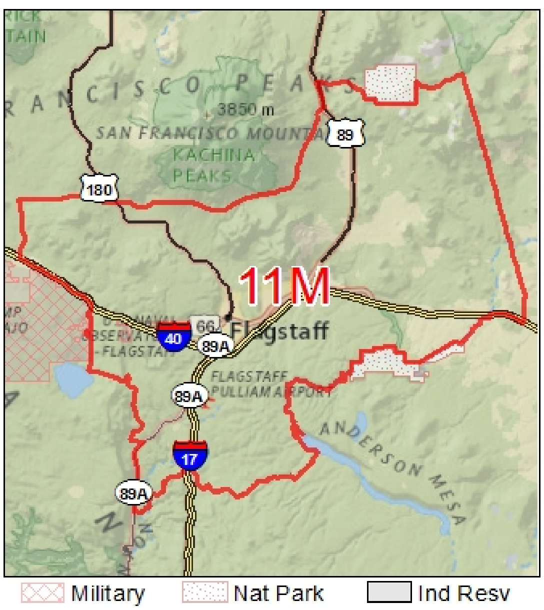


Figure 99: Hunting Unit 11 M, AZGFD

Game management (hunting) unit 11M (Region II) is located in the analysis area just north of Flagstaff. The AZGFDt manages for the following species within this unit - antelope, black bear, elk, mule deer, and Merriam's turkey. The pronghorn hunt occurs in August thru September. The archery bear hunt in Unit 11M is combined with Unit 6B and occurs in the early fall. The elk hunt is September thru December, and the deer hunt is August thru January (AZGFD, website 2013).

Figure 100: Map of Hunting Unit 6A, AZGFD

Game management (hunting) unit 6A (Region II) is located in the analysis area near Mormon Mountain. The AZGFD manages for the following species within this unit - black bear, elk, mule deer, Merriam's turkey, white-tailed deer, javelina, mountain lion, bighorn sheep, tree squirrel, and waterfowl.

On November 2, 2005, the Forest Service announced final travel management regulations governing OHVs and other motor vehicle use on national forests and grasslands. Under the new rules, forests that do not restrict OHV travel to "designated roads-and-trails" must do so. The Coconino National Forest signed a Record of Decision on the Travel Management Project on September 28, 2011 (USDA, TMR Record of Decision – Coconino NF 2011). Implementation of these new rules went into effect on May 1, 2012.

Forest Orders that affect recreation activities within the analysis area are Campfire Restrictions (Order Number 04-15-05-F), Camping/Campfires Prohibited (Order Number 04-112-R), Road Restrictions on Roads Being Obliterated (Order Number 04-99-10-E), Dispersed Camping Stay Limits (Order Number 04-99-08-R).

There is a proliferation of user-created or unauthorized trails within the analysis area. These trails have developed as a result of use by a variety of user groups - including hikers, runners, dog walkers, mountain bikers, equestrians, and motorcyclists. Also, it is common for many trail users (hikers, mtn. bikers, equestrians) to use old road beds or skid trails as well as old fire control lines used for prescribed fires.

Trails

The following USFS trails and/or segments of the trails are located within the analysis area.

Table 162: Existing Forest System trails located within the FWPP analysis area

Name	Length (miles)	User Type	Level of Use	Season of Use
Lower Oldham #1	5.5 mi.	Hiker, mtn. biker, equestrian	moderate	April - November
Brookbank #2	2.5 mi.	Hiker, mtn. biker, equestrian	moderate	April - November
Sunset Trail #23	4.0 mi.	Hiker, mtn. biker, equestrian	moderate	April - November
Pipeline #42	2.8 mi.	Hiker, mtn. biker, equestrian	heavy	April - November
Little Elden #67	4.7 mi.	Hiker, mtn. biker, equestrian	moderate	April - November
Upper Oldham	1.5 mi.	Hiker, mtn. biker, equestrian	low	April - November
Rocky Ridge #153	2.2 mi.	Hiker, mtn. biker, equestrian	moderate	April - November

Name	Length (miles)	User Type	Level of Use	Season of Use
*Arizona National Scenic Trail	9.8 mi.	Hiker, mtn. biker, equestrian	moderate to heavy	April - November
*Fort Valley Trail System – Includes Secret and Upper Moto Trails	6.7 mi.	Hiker, mtn. biker, equestrian, motorcyclists	moderate	April-November
*Mormon Mountain Trail #58	3.0 mi.	Hiker, mtn. biker, equestrian	moderate	April-November
*Dairy Springs Trail #136	0.5 mi.	Hiker (interpretive trail)	moderate	April-November
*Ledges Trail #138	1.0 mi.	Hiker, mtn. biker, equestrian	moderate	April-November

*Segment or portion of the trail within or adjacent to the FWPP analysis area.

The Flagstaff Loop Trail is approximately 42 miles in length and encircles the city of Flagstaff. It is comprised of many existing trails on different land jurisdictions. USFS trails as part of the Flagstaff Loop Trail within the project area include Lower Oldham #1, Rocky Ridge #153, and Pipeline #42.

Trailheads

The following trailheads are located within and/or adjacent to the analysis area.

Table 163: USFS trailheads located within the analysis area

Name	General Location	Comment
Schultz Creek / Rocky Ridge TH	Approximately ¼ mile north of FR 420 and FR 557 junction	Facility includes parking area, information kiosk, trail signs, and a hitching post for equestrians.
Sunset TH	Schultz Pass area (off FR 420)	Facility includes parking area, information kiosk, trail signs, and a hitching post for equestrians.
Schultz Tank TH	Schultz Pass area (off FR 420)	Adjacent to the analysis area. Facility includes parking area, information kiosk, trail signs, and a single-vault toilet.
Buffalo Park TH	Located off Cedar Avenue (near USGS buildings)	City of Flagstaff Park – adjacent to project analysis area.
Mormon Mountain TH	Adjacent to Dairy Springs Group Campground (0.6 mi.	Facility includes parking area, information kiosk,

Name	General Location	Comment
	west of FR 90)	and trail signs.
FR 240/90 TH	Located at the junction of FR 240 and FR 90	TH parking area with kiosk to inform visitors about TMR guidelines.

There are several impromptu parking areas within the analysis area including along FR 557 where Lower Oldham and Rocky Ridge Trails junction. Forest visitors created this ad hoc parking site by parking their vehicles just off the roadway to access West Elden climbing area and the nearby trails. Also, there is a popular parking area at the east end of FR 522, which provides access to Kachina Peaks Wilderness.

Recreation Special-Use Events

The following recreation special-use events (e.g. running, biking, hiking, etc.) take place within and/or adjacent to the analysis area.

Table 164: Special-use events that occur within the FWPP analysis area

Name / Type of Event	# of Users	General Date(s)	Location (general route description)	Notes
MBAA / Mtn. Biking Event	300	mid-May	Fort Valley Trails to Dry Lake Hills	Stage at Fort Valley TH of off FR 164B.
Coconino County Parks & Rec Dept. / Hiking Tour	22 per trip at 7 trips (~144 total)	June - Oct.	Mt. Elden and Dry Lake Hills Trails: Brookbank, Rocky Ridge, Fatman's Loop	Issued a permit but not used due to limited interest; may pursue a future permit.
Shadows Foundation / 10-mile and 10K Running Event	100	late June	Elden Lookout road (FR 557) to Sunset trail to Heart trail to Sandy Seep trail to Sandy Seep TH	Staged on private land at the jct. of FR 557 and 420
Chiropractic Joint / Benefit Walk	75	mid-Sept.	Elden Lookout Trail	
NATRA / Soulstice Mtn.Trail Run	225	mid-Oct.	Sunset TH to Brookbank trail to Little Gnarly trail to Schultz Creek trail to Sunset TH	14th year; stage at Sunset TH
Aravaipa Running / 50-mile Running Event	75	late Sept.	Lower Oldham Trail to Rocky Ridge Trail to Upper Oldham Trail to Sunset Trail to Heart Trail to Little Elden Trail to Little Elden Springs Rd. to Schultz Pass Rd. to Schultz Creek Trail	1st year in 2012; staged @ Buffalo Park

Climbing

The West Elden climbing site is located within the project area – adjacent to Elden Lookout road at the jct. of Lower Oldham Trail. West Elden is one of Flagstaff's oldest and most popular climbing areas. It is made up of an 80-foot tall Dacite cliff which hosts a large number of traditional routes. Over the years it has gained popularity and is now found on many websites and in a number of climbing publications.

Outfitter Guides / Youth Camp

Flagstaff Climbing, formerly called Vertical Relief, provides guided climbing opportunities at West Elden under a special-use permit.

Mormon Lake Lodge provides horse-back riding in the forest under a special-use permit. They offer 1-hour, 2-hour, and half-day rides. They use trails and roads south of the FWPP analysis area near Mormon Mountain. The stables are generally open May-September.

Saint Joseph's Youth Camp is located at the junction of FR 90 and FR 240, and is about 1.5 miles southeast of the FWPP boundary. The camp provides week-long activities for youth (ages 8 – 15) visiting from other parts of the state/country. Activities include arts and crafts, hiking, archery, horseback riding, mountain biking, campfire and telescope nights, and others. Some of these activities, such as hiking and mountain biking, can occur within the project area.

Dispersed Camping

Dispersed camping has increased throughout the Flagstaff wildland urban interface in the past several years. In many areas, this has caused resource impacts such as soil compaction and erosion, loss of vegetation, increased fire hazard, displacement of wildlife, and accumulation of trash and human waste.

To help prevent unacceptable resource damage, disturbance to wildlife and reduce fire hazard from dispersed camping, the Forest Service has designated 14 campsites along FR 522 (Freidlein Prairie Road) for dispersed camping. Approximately 1 mile of FR 522 is along the northern boundary of FWPP.

The Coconino National Forest implemented new travel rules for motor vehicles on May 1, 2012, per the Travel Management Rule Record of Decision (signed September 2011). The Motor Vehicle Use Map (MVUM) is the legal document that shows where it is legal to drive a motor vehicle. The current map was published May 1, 2013. The MVUM is to be re-published every year.

The dot notations on the MVUM indicate corridors where vehicles can be driven off-road up to 300 feet to accommodate "car camping." These areas are known as "camping corridors." Within the DLH portion of the FWWP analysis area, there is a 1-mile camping corridor located on FR 420 (Schultz Pass Road) -approximately 1.5 miles north of the junction with FR 557 (Elden Lookout Road). Near Mormon Mountain, there is roughly a 4-mile camping corridor located on FR 132 - from the junction of FR 90 to the junction of FR 132D (USDA, MVUM – Coconino NF, 2013).

Wilderness

The Kachina Peaks Wilderness, located approximately 6 miles north of Flagstaff, is adjacent to the FWPP analysis area. The U.S. Congress designated the Kachina Peaks Wilderness in 1984 and it includes a total of 18,616 acres. The Kachina Peaks Wilderness is in close proximity to the northern boundary of the project area – near the junction of FR 522 and FR 6273. There is an ad hoc trailhead at this road junction that provides access to the Kachina and Weatherford Trails located within the Wilderness area.

Road System

Forest Service roads within and/or adjacent to the DLH area that are heavily used by recreationalists include FR 420 (Schultz Pass Road), FR 522 (Freidlein Prairie Road), FR 557 (Elden Lookout Road), and FR 556 (Little Elden Springs Road). These roads provide recreationists with access to trailheads, dispersed camping sites, climbing and hang gliding locations, as well as hunting opportunities, recreational driving experiences, scenic and wildlife viewing, birding, and fuel-wood gathering. Forest roads are occasionally used for recreational special-use events (e.g. running or biking events), and also for shuttling purposes for activities such as downhill mountain biking (aka gravity riders).

FR 789 is a decommissioned road that begins at its junction with FR 420 (Schultz Pass Road). The old road location crosses Schultz Creek at this point and is currently closed with a gate. It then climbs to the mesa on top of the Dry Lake Hills and passes through a parcel of land owned by the Navajo Nation. The road passes close to the seasonal "dry lake" on the top of the Dry Hill Hills and terminates on the western edge of the mesa. Much of FR 789 is used as a trail by hikers, mountain bikers and equestrians – in particular, the segment from FR 420 to the top of the mesa where it serves as a link with Brookbank Trail. This portion of FR 789 is known as the "Little Gnarly Trail" by locals and trail guide maps/books. It is a popular route and is used on occasion for special-use running and biking events.

Forest Service roads within and/or adjacent to the Mormon Mountain area used by recreationalists include FR 90 (Mormon Mountain Road), FR 132, FR 132A, FR 240, and FR 248. These roads are used by recreationalists in a similar fashion as the Dry Lake Hills area, except there is no mountain biking shuttling activity. Also, FR 90 is a critical access road for Mormon Mountain Lodge, Saint Joseph's Youth Camp, Dairy and Double Springs Campgrounds, private residents, and a number of recreation residence or cabins located on the national forest via a special-use permit.

Environmental Effects

The timeframes for direct and indirect effects will include the potential for eight to ten years of project implementation, followed by a period of recovery lasting up to ten years. The analysis area for direct and indirect effects is the project area. The timeframe for cumulative effects is 20 years and the area includes the Flagstaff Ranger District of the Coconino National Forest.

Alternative 1: No Action

Direct & Indirect Effects

Under the No Action Alternative, recreation activities would be managed as they currently are without impacts from fuels reduction treatments associated with FWPP other than those approved under previous decisions (e.g. Jack Smith Schultz and Eastside Forest Health and Fuels Reduction Projects). There would be no direct, indirect or cumulative effects to trail-use, dispersed camping, hunting, driving for pleasure, birding, climbing, special-use events (e.g.

running or biking events), the Mount Elden Environmental Study Area and other recreational activities.

However, in the event of an uncharacteristic high severity wildfire such as the Schultz Fire (2010), the existing recreation infrastructure and activities could be drastically impacted.

For example, several trails were severely damaged by the Schultz Fire and subsequent flooding - including Weatherford Trail #102, Waterline Trail, Deer Hill Trail #99, Little Elden Trail #69 and Little Bear Trail #112 (see Figure 101).

Figure 101: Little Bear Trail, Post-Schultz Fire, October 2010

These trails were closed during and after the Schultz Fire for public safety and for resource concerns. The Deer Hill Trail remains closed because many segments of the trail are considerably damaged; the trail will need to be relocated at a substantial economic cost before being re-opened. Also, the Little Elden Springs Horse Camp was closed during the Schultz Fire and subsequent flooding events.

For many months after the fire, standing dead trees were a serious public safety hazard because they are more susceptible to falling due to their charred condition. It can take several years for these trees to fall on their own accord depending on a number of variables: weather and atmospheric conditions (e.g. wind, snow loading, freeze/thaw cycles, etc.); topography (e.g. aspect, slopes, etc.); burn-severity (e.g. impact to root system, burned tree bole – cat face, etc.); and ongoing flooding. Trees with a detached limb or tree top are referred to as "widow-makers" (Figure 102) because the object (e.g. detached limb) can become dislodged by wind and fall onto equipment and personnel. Across the nation, there have been a number of fatalities due to widow-makers. The Schultz Fire caused a number of impacts to trails, but subsequent flooding events were more detrimental and resulted in more significant damage to the trails. Large debris flows removed major sections of the trail – often completing removing any evidence of a trail and depositing large boulders and debris onto the trail (Figure 103).

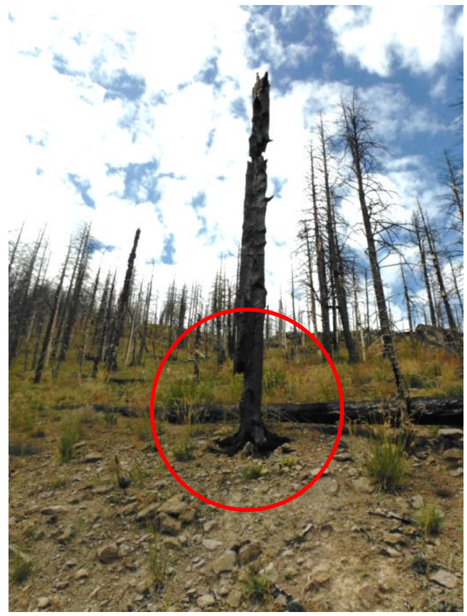


Figure 102: Widow-maker tree with detached limb (above); dead standing tree with little holding wood (right); pictures from Waterline Trail damaged by Schultz Fire.

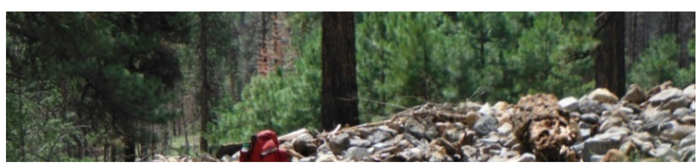


Figure 103: Debris flow onto Little Elden Trail, Post-Schultz Fire.

The threat of catastrophic wildfires is increasing due to un-managed vegetation which would severely impact recreation values and experiences – similar to the Schultz Fire (see also the Fire & Fuels Specialist Report). Fires of greater intensity and scope, including stand replacement fires, can result in changes to the landscape, its character, and visual quality. This would reduce or significantly diminish the quality of recreational settings and experiences that are desirable - including recreational driving, trail-use (e.g. hiking, biking, horse-back riding), and hunting. Areas currently used for dispersed camping, recreation special-use events (e.g. running and biking events) and rock climbing would likely be unsafe and less appealing for these activities after such a fire – possibly resulting in closures (short-term and long-term depending on the severity).

This alternative would not meet the project's desired conditions or forest plan direction. It would not move the project area toward Restoration and Adaptation of Recreation Settings. No action would result in the current wildfire hazards and declining forest health and it is reasonable to assume that these hazards increase each year and could be exacerbated by climate change. A severe wildfire within the project area would change the landscape and likely alter the Recreation Opportunity Spectrum – resulting in diminished scenic qualities and detracting recreational values.

Cumulative Effects

The cumulative effects analysis area is the northern portion of the Coconino National Forest – above the Mogollon Rim. The timeline for analysis is 20 years because most long-term effects of the alternatives are assessed out to a 20 year timeframe (with the exception of large scale high severity wildfire which is more difficult to project).

The following is list of actions relating to recreation management and recreational activities considered in the cumulative effects analysis for this project:

- Past activities that created the current conditions include forest management practices related to timber harvest and fire suppression (i.e. Eastside Fuels Reduction Project, Schultz Fire), dispersed and developed recreation management – including construction of the Arizona Trail, Travel Management Rule, special-use events and outfitter guide operations.
- Present and future activities such as vegetation management (i.e. 4FRI projects), trails management – ongoing operation and maintenance of existing trails, and pending trail planning projects - Mount Elden / Dry Lake Hills Planning Project.

The cumulative effects of past management activities are visible as the existing conditions.

The short term cumulative effects (1-5 years) of the No Action alternative combined with similar current and future restoration treatments and prescribed burning projects are expected to be negligible, unless additional large scale, high severity wildfires occur in the northern portion of the Coconino National Forest. If a wildfire burned recreational infrastructure including USFS trails and recreational features (i.e. trailheads), there would be long term negative changes (10 to 25 years). Trails impacted by a severe wildfire would be closed for public safety and it's probable such trails would be damaged by subsequent flooding. This would result in long-term closures and displacement of trail use to other trail systems in northern Arizona. This could lead to an increase in the construction of un-authorized trails.

Irretrievable and Irreversible Commitment of Resources

This alternative does not propose changes and thus does not have any irretrievable and irreversible commitment of resources except those associated with a wildfire, described above.

Effects Common to all Action Alternatives

Direct & Indirect Effects

Campfire Closure & Temporary Area Closures

The campfire closure order would impact recreationalists, most directly dispersed campers that would prefer to have a campfire throughout the DLH portion of the project area. The campfire closure order would likely result in less dispersed campers within the closure area because of campers seeking legal campsite locations to have a campfire.

The campfire closure order would restrict campfires within the closure area indefinitely. This would displace the use of campfires to areas outside of the closure area. Also, the campfire closure order would help reduce the potential for human-caused wildfire and lessen the likelihood of a wildfire that could cause severe destruction and severely impact recreation opportunities throughout the DLH area for 10 – 20 years and possibly beyond.

The temporary area closures during implementation would have short term (likely less than a year) impacts on public access within small portions of the project area. Recreationists would be able to access other areas of the project where implementation is not taking place, and temporary closures would be communicated early to the public and partners in order to facilitate movement of recreation activities in other, non-affected portions of the forest.

Conventional Ground Based Harvesting

Conventional logging typically has some degree of short term to mid-term effects on recreational use and activities. During logging operations, areas would be closed to public access for safety purposes including roads, trails, and other recreation facilities (e.g. parking areas, trailheads, etc.). These temporary closures would directly affect a number of recreation activities such as driving for pleasure, dispersed camping, hunting access, trail use, special-use events (e.g. running and biking races, family re-unions, etc.), and outfitter guide operations (e.g. climbing).

Mechanical treatments would likely have temporary effects on the quality of the experience for some forest visitors. The immediate and substantial change in appearance of treated sites results in an effect on the visual quality of the recreation driving experience (see the Scenery section). Design features include efforts to reduce scenery impacts, and limit forest treatment activities within the project area during high-use weekends and holidays (e.g. Memorial Day, 4th of July, Labor Day, etc.), especially in locations where recreation based infrastructure is located (e.g. trails, trailheads, etc.). Also, temporary closures of forest roads and/or portions of the project area during implementation would be coordinated with AZGFD during hunting seasons to reduce impacts on hunters.

Mechanical treatments in the area open to dispersed camping would likely result in immediate changes to the quality and quantity of camping opportunities for both short-term and mid-term. The disturbance from mechanical thinning (temporary and skid road construction and use, tree removal, ground vegetation disruption, slash piles, etc.) can disrupt both the aesthetic and physical qualities that make a campsite desirable, including for persons seeking would, cover, etc. While sites could be rendered unusable by mechanical treatments, these effects will not be permanent, with use anticipated to increase in the mid to long-term. As initial ground disturbance heals, slash piles are burned and the beneficial effects of treatments become evident, the sites would likely be desirable again. It is likely that, in the short term (up to 1-2 years after mechanical treatment) that dispersed camping use would be displaced to other sites both inside and outside of the project area by the treatment activities. As a result of this displacement, use of existing sites that are not planned for treatment within the project area and sites outside the project area may see increases in use. This use is likely to lead to some effects to these sites from the increased use. However, as the overall amount of dispersed camping use to be displaced is relatively low, the associated effects of displace to other sites can also be seen as insignificant.

Logging operations in areas where Forest Service system trails exist would have immediate effects on the trails and the quality of recreational experience derived from them. The disturbance from mechanical thinning (temporary and skid road construction and use, tree removal, ground vegetation disruption, slash piles, etc.), while temporary, can impact sections of trails making them hard to follow and in some cases temporarily unusable. The duration of this effect would likely last from a few months to possibly a few years, once the logging operations are concluded and trail rehabilitation work is completed. In addition, some trails may be used as temporary skid trails to move logs and slash, often resulting in ruts and damage to the trail tread (aka trail prism) and trail drainage structures (e.g. water bars, rolling dips, reverse grade, etc.) during implementation. Also, logging skid trails that cross or bi-sect a Forest Service system trail may cause similar impacts and can affect the drainage of the trail resulting in increased erosion during implementation. However, after implementation, contractors would be required to return the roads and trails to their previous (pre-disturbance) condition, and BMPs would decrease impacts associated with harvesting activities, including erosion and rutting.

A number of trail designed features were developed to minimize impacts, especially on the Arizona National Scenic Trail. These include: (1) crossing or using the Arizona National Scenic Trail as a skid trail would be done sparingly and only if no other alternative exists; (2) not implementing jack straw treatments within 1,000 feet of the Arizona National Scenic Trail; and (3) not using motorized equipment on National Scenic, Historic and Recreation Trails, or other forest system trails if these are used for control lines. Also, USFS single-track trails would be avoided for use as a skid trail or temporary road. Refer to Chapter 2 for the full list of design features for trails.

Social or unauthorized trails within the project area where logging operations occur would be directly impacted by mechanical treatments. Segments of these unauthorized trails would be affected by the development of temporary roads, skid trails, and roadside landings. The impacts from mechanical treatments to segments of unauthorized trails would result in ground disturbance, tree removal, and vegetation alterations. It is anticipated that such unauthorized trail segments would no longer be usable during and after logging operations as the contractor would not be required to return unauthorized trails to their pre-disturbance condition. There are no design features to rehabilitate unauthorized trails post-treatment.

An indirect effect of conventional logging may result in the development of unauthorized trails as a consequence of temporary roads and mechanized skid trails. For timber extraction, temporary roads are created and rubber tired grapple skidders are used to drag whole trees to a roadside landing area – creating a skid trail. Once the logging operations are completed, these temporary roads and skid trails can inadvertently become unauthorized trails used by a number of forest visitors including hikers, mountain bikers, equestrians, ATV enthusiasts, and motorcyclists. Design features to address this potential impact include the use of physical measures such as re-contouring, pulling slash and rocks across the line, placing cull logs perpendicular to the route, and disguising entrances onto temporary roads and skid trails to hasten the recovery.

Special-use activities, such as running or biking events, that use trails or sites that are closed to public access during logging operations would be directly impacted. Also, permits would not be issued for family re-unions or other group activities within the project area during logging operations to ensure public health and safety. A coordinated effort would be made with sponsors of recreational special-use events to minimize the impacts on such events within the project area during implementation. Alternative locations would be identified to meet the needs of the special-use event if logging operations conflict with preferred locations and cannot be resolved through timing.

Direct effects on rock climbing use from treatment activities would be minimal and of short duration. It is likely that treatments in climbing areas would consist of hand thinning, mechanical pilling of slash, and burning. These activities would cause only temporary disturbance to rock climbing opportunities from noise and would only minimally and temporarily impact visual quality.

Logging operations proposed within the urban interface would have the immediate effect of noise and public safety hazards during mechanical treatment, and the disturbance to social trails and routes used by the public from vegetation removal, slash piles and other treatment effects.

Designed features, as described in Chapter 2, for recreation and scenery would be implemented to minimize the impacts on forest visitors and recreational activities.

Roadside landing areas used for logging operations become trampled and denuded of vegetation. A short duration after logging operations are completed (i.e. 2-3 years) these landings become a desired dispersed camping/parking area for forest visitors. Additionally, forest visitors gathering fuel wood congregate to these areas because of the open access and abundance of slash and woody material.

Logging operations should not have a major effect on restricted motor vehicle use for the Mount Elden/Dry Lake Hills area, although the opening up of sites of trees would indirectly allow easier access for persons wanting to drive off road, and thus make it somewhat more difficult to administer off-road motorized travel restrictions.

Thinning and pile burning within the Mount Elden Environmental Study Area would help restore natural conditions. In the short-term (1-2 years) these operations would detract from the user experience due to visual impacts; however in the mid-to-long term (3-20 years) they would enhance the experience of those visiting the area by reducing the likelihood of a catastrophic fire and improving the diversity of vegetation and scenery.

Hand Thin and Pile

Hand thinning usually has little or no short term effects on recreation management. Trees are cut down, and then cut (lopped) into smaller lengths that are collected and stacked for future pile burning. Project design features would require most slash piles to be a safe and reasonable distance from trails and recreation facilities. Similar to roadside landings, forest visitors seeking fuel wood opportunities would likely harvest hand piles to remove logs and branches.

Machinery on Steep Slopes

The effects of steep slope harvesting equipment would be similar to the ground based logging noted above. However, large rocks and other debris could become dislodged and move downhill from the equipment onto trails and roads below the harvesting operation. Project design features require the trail and road to be closed to public access during operations and that FS system trails are restored to USFS standards post-treatment.

Aspen, Grassland and Electronic Site Protection Treatments

Aspen treatments to stimulate new sprouting require protection from ungulate browsing following treatments. A variety of treatments would be used including removal of invading conifers within 100 feet of aspen clones, prescribed fire, ripping, planting, fencing and/or cutting of aspen to stimulate root sprouting. Many aspen clones currently have dead and down and dead standing trees. Treatments would not be very noticeable with the exception of fencing, which would not impede or cross a FS system trail when constructed. Thus there would be no direct or indirect effects on recreation use or activities.

There would be no effects to recreation management from grassland restoration or electronic site structure protection activities.

Prescribed Fire

Depending on fire severity, effects from prescribed burning would include: charred soil and vegetation immediately following burning; charred bark up to 10 feet from the ground; needle and leaf scorch typically less than 20 feet from the ground; and, loss of understory trees, trees with old scars or trees with large accumulations of dead fuels at their base. In areas of moderate to high severity, openings may be created as a result of more extensive tree mortality.

Prescribed burning would create short term and temporary effects on recreation opportunities. Areas where these treatments are implemented may be closed to public access during operations for safety purposes. This may temporarily alter vehicular access (i.e. driving for pleasure, hunting, etc.), trail use, and other recreational activities such as dispersed camping and climbing. Recreationalists would not be able to access areas that are closed during burning operations. In addition, it may affect special-use events (e.g. running and biking races). Design features include working with event coordinators to minimize the impacts on such events within the project area during implementation. Alternative locations would be identified to meet the needs of the special-use event if forest management activities conflict with preferred locations and cannot be resolved through timing. Pile burning treatments would have little effect on recreation management; it may require areas to be closed to public access during operations if public safety is a concern. Design features would ensure piles are at a safe and reasonable distance from trails and recreation facilities.

Prescribed burning operations may have the indirect effect of displacing general forest use short distances spatially as users (i.e. hikers, joggers, dog walkers, mountain bikers, equestrians, etc.) avoid slash piles, stump holes and other effects of treatment. As a result, new social trail networks could evolve.

Smoke from prescribed fire operations can negatively impact the health of forest visitors in the immediate area, especially people with respiratory problems. This could affect dispersed campers, hunters, and trail-users near the prescribed fire operations. However, direct effects of initial and maintenance burning on dispersed camping would be minimal and short term. Generally campers in areas to be burned are informed about the burning operation and are asked to leave for the duration of the burn for their safety. Smoke from burning could cause discomfort to campers in the project area during burning but usually disperses within 24 hours. For the duration of a few months after initial and maintenance burning, ash on the forest floor is likely to make camping less pleasurable as it tends to blow in light breezes and stick to surfaces like shoes, tents and clothing. During implementation, smoke could obscure views of the surrounding terrain and mountains. Effects to residents and visitors in the project areas may be dissatisfaction that their views and scenic features are obscured. Very smoky conditions typically occur during the first entry of prescribed burning due to heavy fuel loadings. There can be lingering smoke for two weeks to a month after burning as stumps, large logs and roots smolder. Smoke from repeat burns should lessen, since less fuel would be consumed.

There may be indirect effects of smoke as well since it drifts and is pushed by air currents. Nearby developed recreation sites, houses and subdivisions, and the communities may experience reduced visibility and smoky conditions. Dispersed campers and other recreationists may experience reduced visibility and smoky conditions in some places near the project area.

Transportation System

Maintenance on roads within the project area would be necessary prior to implementation, including reconditioning and resurfacing of FR 420, 556 and 132.Road maintenance activities would improve the condition of the existing road system. This would have a direct short-term impact on forest visitors that intend to use the forest as these roads would be closed during maintenance operations. This would affect vehicular access for a number of different recreational activities including driving for pleasure, dispersed camping, hunting, climbing, special-use events, and trailhead access where applicable. Also, it would impact the many recreationalists who drive to top of Elden Lookout road (FR 556) to enjoy the views, picnic, access trails, hunt, hanglide, and those shuttling mountain bikes for downhill mountain biking. However, the road maintenance would benefit forest visitors accessing the area in vehicles in the mid and long term by improving the road

Construction of temporary roads (approximately 21 miles under Alternative 2, 15 miles under Alternative 3, and 13 miles under Alternative 4) would result in moderate effects on recreation use and activities. The temporary roads, where they cross existing FS system trails and unauthorized trails, would close those segments of the trail and disrupt that use during logging operations; although the temporary roads would be rehabilitated after the thinning treatments are completed. Design features would be used to close entrance points and BMPs for watershed would ensure drainage is re-established and the roads can rehabilitate. The temporary roads would begin to recover and should be mostly recovered and less noticeable to the casual observer in 5 to 10 years after the project is completed, and the roads are rehabilitated. It would be anticipated that the temporary roads may receive inadvertent trail use post-treatment; this may include non-motorized and motorized use. Decommissioned roads would begin to recover after treatment and would be mostly recovered and less noticeable to the casual observer in 5 to 10 years.

Cumulative Effects

The actions considered in this discussion are those that have occurred in the recent past (10 years), as well as those reasonably foreseeable land management actions, and the cumulative effects of those actions and this proposal. Management activities that occurred prior to this time helped create the current condition described under the affected environment section. For this discussion, actions to consider are those that occur in areas immediately within or adjacent to the project area. These include, affect and are affected by:

- Ongoing dispersed camping within the project area, and on lands surrounding the project area.
- Ongoing dispersed recreation (day use) in and around the project area including mountain biking, rock climbing, recreational driving, hiking, horseback riding, etc.
- Ongoing latent community use and social trail use in and around the project area, including for access to general forest areas.

- Upcoming local, regional and national motorized access and Travel Management Rule policy changes for off-road vehicle use.
- Special uses and areas within the project area, including commercial operations such as climbing guides, riding stables.
- Areas where special restrictions are in place, such as motorized vehicle restrictions, shooting and camping restrictions, etc.

Predominant semi-primitive non-motorized and semi-primitive motorized recreation settings, with some less highly developed settings in the area, would add to the presence of the desired wildland recreation setting in the surrounding landscape. Surrounding areas are also likely to maintain and enhance some semi-primitive settings. The exact amount is unknown, but subsequent project work in these areas is intended to continue this trend.

Although it is difficult to estimate where displaced campers may go, it’s predicted that major forest roads outside of the treatment areas may see increased use, although this should not be a significant displacement, since there is not a significant amount of overnight camping in the project area now. As the current and historic camping use in the project area has been dispersed in nature, it is reasonable to assume that displaced campers would continue to seek this type of use here and in other areas. Displaced campers may add to current camping impacts in locations adjacent to the project area causing a slight increase in resource impacts.

Alternative 2: Proposed Action with Cable Logging

Direct & Indirect Effects

Under Alternative 2 the direct and indirect effects would be the same as those identified in the effects common to all action alternatives section above, but the addition of cable logging operations would most directly impact trail use and aesthetics within the project area. The 12-foot wide cable logging corridors would directly impact existing USFS trail and unauthorized trail activities where they intersect.

The adjacent map (Figure 104) shows the location of USFS trails and the proposed cable logging locations. USFS trails that would be directly impacted by cable logging operations includes a good portion of Schultz Creek Trail, three segments of Brookbank Trail, Upper Oldham Trail, and Secret Trail near FR 6273 (see Table 165).

Figure 104: Alternative 2 Proposed Treatments with Trails and Roads Displayed

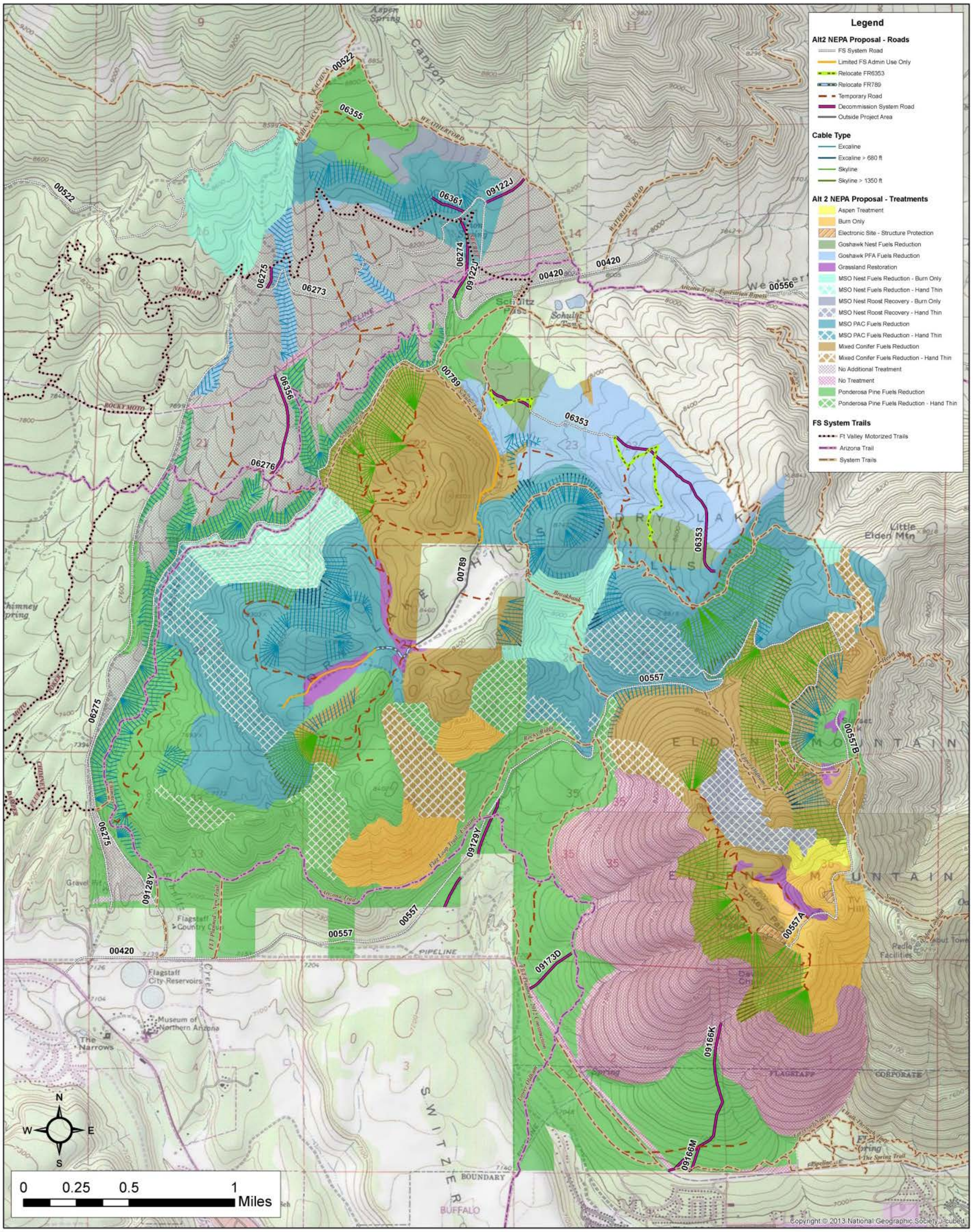


Table 165: USFS trails with segments located within proposed cable logging locations.

Trail Name	*Length (mile)	Description of trail segment location and type of Logging Operation (Skyline or Excaline)
Schultz Creek	1.9 mi.	Two different segments of the trail within cable logging locations. (1) Southern portion near jct. of Rocky Ridge Trail = 1.1 mi. – Excaline (2) Northern portion near jct. of FR 789 = 0.8 mi. – Skyline
Brookbank	1.0 mi.	Three different segments of the trail within cable logging locations. (1) Sunset Trail jct. to the southwest = 0.5 mi. – Skyline (2) Northeast of Dry Lake area = 0.4 mi. – Excaline (3) Directly east of Dry Lake area = 0.1 mi. – Excaline
Upper Oldham	0.68 mi.	Trail segment is in the upper portion of the trail – Skyline
Arizona	0.36 mi.	Trail segment due east of FR 6356 - Excaline
Secret	0.25 mi.	Trail segment is located north of FR 6273 – Excaline

*Denotes approximate length of the trail located within the proposed cable logging locations.

There are a number of unauthorized trails that would be directly impacted by the cable logging corridors as well; many of which have been named by local trail enthusiasts – including Middle Oldham, Steel Reserve, Private Reserve, Upper and Lower Wasabi, Jedi, Double D as well as others. The areas and trails being treated with cable logging systems would be closed to public use for public safety concerns during operations. The trail tread, soil and vegetation near these trail intersections would be significantly disturbed by the cable logging operations. This would disrupt trail use and other recreational activities in these areas during logging operations and likely until the sites can be properly rehabilitated and restored. In addition, the cable logging operations would directly affect the aesthetics in the areas being treated, which would impact the experience of forest visitors – especially those driving for pleasure seeking desired viewsheds (see the Scenery section of this chapter).

In addition, the hanglider launch pad above Devil's Chair on Mount Elden is located adjacent to a cable logging location. This would require the launch pad to be closed, impacting the use by hangliders and paragliders during logging operations. Also, it may result in disturbance to the surrounding soil and launch pad itself.

USFS trails within close proximity to cable logging locations would be indirectly affected by this activity as it would impact use (e.g. trail closures during operations), could temporarily accelerate gravitational erosion and debris onto the trails as a result of cable logging operations, and a change in the vegetative composition which could affect the aesthetic value of the area to those using the trails. The following trails have a significant segment of the trail located within 500 feet of cable logging locations (Table 166).

Table 166: USFS trails with segments located within 500 feet of cable logging locations (CLL)

Trail	General description of trail segment location
Arizona	Several segments of the trail are near CLL, especially just north of FR 789.
Schultz	Most of the trail is located within or close proximity to CLL.
Secret	There are a couple of segments near CLL – primarily near Orion Spring.
Sunset	There are two segments near CLL – near the jct. of Brookbank Trail and near the Oldham Park area.

In addition, FR 420 and FR 557 are adjacent to cable logging operations and would have similar direct and indirect impacts as those using the trails. This would affect a number of recreational activities including driving for pleasure, hunting, and dispersed camping.

Cumulative Effects

The cumulative effects for Alternative 2 are the same as those identified in the Effects Common to All Action Alternatives section, but would also impact the MEDL planning project. The MEDL proposed action includes new trail construction, relocation of existing FS trails, incorporation of some user created trails (i.e. downhill mountain bike trails), an access trail for climbing at West Elden, and improving an existing hanglider launch pad in Turkey Park area. All of these proposed actions are either completely located within or have a significant portion located within the cable logging corridors and would be affected by such activity.

Alternative 3: Proposed Action without Cable Logging

Direct & Indirect Effects

Alternative 3 would not have the impacts on recreational activities identified in the previous section from cable logging. However helicopter logging would likely increase the need for area closures for public safety because of the inherent danger with this type of activity. There may be an additional need to secure the closed areas from forest visitors to ensure public health and safety concerns.

Cumulative Effects

The cumulative effects for Alternative 3 are the same as those identified in the Effects Common to All Action Alternatives section above.

Alternative 4: Minimal Treatment

Direct & Indirect Effects

Alternative 4 would have similar effects as those described in the Effects Common to All Action Alternatives section, except that the impacts are anticipated to be less than Alternatives 2 and 3 due to fewer acres being proposed for treatment and a reduced mileage of temporary road construction. However the acres that would not be treated under this alternative would retain the same degree of wildfire hazard as under the Existing Conditions and No Action Alternative.

Cumulative Effects

The cumulative effects are the same as those identified in the Effects Common to All Action Alternatives section above.

Irreversible and Irretrievable Commitments of Resources

The action alternatives focus on reduction of fuels to reduce the threat of high severity wildfire and subsequent flooding in two key areas near the City of Flagstaff, Arizona: the Dry Lake Hills portion of the Rio de Flag Watershed north of Flagstaff, and the Mormon Mountain portion of the Upper Lake Mary Watershed south of Flagstaff. As such, there is no irretrievable or irreversible commitment of resources.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

Amendment 1: Modify Forest Plan language to allow mechanical treatments in MSO PACs up to 18 inches dbh and hand thinning treatments up to 9 inches dbh and prescribed burning within MSO nest/cores. The monitoring requirement specified under the Forest Plan would be amended to include the monitoring plan developed by the Forest Service, U.S. Fish and Wildlife Service, and the Rocky Mountain Research Station referenced in the following section titled, "Monitoring." This amendment would also remove timing restrictions within MSO PACs for the duration of the FWPP project. Treatments within PACs would be accomplished as quickly as possible to reduce the duration of impacts, and would be coordinated with FWS. The purpose of this amendment would be to facilitate treatment in high-priority locations such as Mexican spotted owl occupied habitat to prevent high-severity wildfire. This is based on language in the Mexican Spotted Owl Recovery Plan (2012), which states, "[wildfires] result in the most significant alteration of owl habitat and hence, have the greatest potential for loss of habitat."

Effects to Recreation Management

Amendment 1 would have similar effects to recreation management as noted above.

Amendment 2: Removing language restricting mechanical equipment to slopes less than 40 percent and language identifying slopes above 40 percent as inoperable. This amendment would allow mechanical harvesting on slopes greater than 40 percent within the project area.

It would be necessary to allow for use of specialized mechanical equipment to cut and remove trees on steep slopes to reduce the potential for high-severity wildfire in this project area due to the preponderance of areas with greater than 40 percent slope in the project area. Furthermore, since the Forest Plan was written and amended, mechanized ground-based equipment has progressed to be able to operate on steep slopes more effectively. While this specialized equipment is not commonplace in this region due to the high cost of its use, the approval of the City bond makes the use of such equipment a possibility for this project. In order to be able to utilize such equipment to treat slopes above 40 percent in the project area and meet the purpose and need, this Forest Plan amendment is needed.

Effects to Recreation Management

Use of specialized equipment to treat steep slopes would result in minimal impacts to recreationalists. It would require the closure of trails for public safety as noted above and in areas where trails and other recreation infrastructure is located. However, user created or unauthorized trails within these areas will be impacted by treatments. These unauthorized trails would not be rehabilitated after the treatment is completed and will likely result in displacing this type of activity.

Heritage

Methodology

Heritage analysis was based on a review of previous heritage survey and previously recorded archaeological sites, as well as new survey conducted in support of the proposed action (Whiting 2013). A literature review was conducted via the forest's INFRA and geospatial databases, and archaeological and historic atlases. A sampling plan was developed based on geospatial modeling, including Terrestrial Ecosystem Units (TEU), slope, and elevation (see Haines and

Peters 2013 for technical details on sampling methodology) and received Arizona State Historic Preservation Office (SHPO) concurrence on January 6, 2014.

The archaeological surveys addressed potential impacts resulting from the proposed undertaking including mechanical thinning, temporary road construction, road closure and decommissioning, helicopter logging, cable logging, prescribed fire, and more. The entire project area was sampled based on known and predicted site densities in addition to the mechanical and ground disturbing treatments proposed. Archaeological site density was determined through modeling of district GIS files. Surveys undertaken for the current project have resulted in coverage of 46 percent of the DLH area (1,595 previous survey and 1,908 sample survey) and 62 percent of the MM area (499 previous survey and 1,355 sample survey) (Whiting 2013).

Complete survey is considered one-hundred percent based on pedestrian surveys of no more than 20 meters apart. Surface artifacts and features were identified and documented by use, date, phase, and cultural affiliation. Site condition was noted, with fire fuel loading evaluations also completed for each site. Fire tolerance of a site was determined through examining artifact and feature materials, on site fuel loads, standing dead trees, slash piles, and the fire return interval of the area (has the site burned before historically or prehistorically).

Since surveys were completed prior to development of this specialist report, we were able to use previously recorded sites along with sites identified through the current project's sample survey to analyze effects to archaeological sites from project alternatives.

As all sites considered unevaluated for or eligible the NRHP are managed for no effect or no adverse effect per federal law and local planning guidance, we were able to combine analysis for Alternatives 2, 3, and 4. The effects from Alternative 1 (No Action) are analyzed separately.

Incomplete and Unavailable Information

We based this analysis predominately on a sample of previous heritage surveys in the project area. Samples represent, by nature, an incomplete body of archaeological data for a project area. Previous analyses of archaeological site density (Barrett 2010; Haines and Peters 2013) as well as review of historic atlases and other data sources, however, demonstrate a low likelihood of significant heritage resources in the low site density areas. Surveys undertaken for the current analysis confirm that site density is relatively low in this project, relative to other areas of the Flagstaff Ranger District. Thus, sample survey of those areas is both justified and appropriate for management purposes.

Affected Environment

Existing Condition

Cultural Resource Surveys and Sites

During the last 40 years, 70 cultural resource surveys conducted in the analysis areas have resulted in coverage of 46 percent of the DLH area (1,595 previous survey and 1,908 survey for the current project) and 62 percent of the MM area (499 previous survey and 1,355 survey for the current project).

The following summary of heritage resources in the analysis areas was developed from Haines and Peters (2013), Pilles and Stein (1981), and Whiting (2013). For specific information on sites, see Whiting (2013).

There are 39 historic properties identified within the analysis areas through the 70 previous heritage inventories and consultation efforts. Of the 39 archaeological sites, 25 are prehistoric, one is protohistoric, 10 are historic, two are multi-component which means they include more than one temporal period, and one is the San Francisco Peaks TCP. Twenty-seven of the sites and the TCP are in DLH and the remaining 11 sites are in the MM area. These sites reflect the long history of human occupation and use of the area from late Archaic hunter gatherer period through the prehistoric and proto-historic periods and culminating with middle 20th century sites from Euro and Native American use and settlement of the area.

The earliest sites date to the late Archaic/early Formative period (150 B.C. – A.D. 700) and are represented by a lithic scatter and a rock shelter. These sites are related to hunting and gathering activities that took place on the forest from approximately 3,500 to 1,300 years ago.

Approximately half of the prehistoric sites represent the Formative Pueblo time period and most are categorized as Sinagua, based on diagnostic artifact and feature types. These sites include pit houses, small pueblos, a rock shelter and artifact scatters, and date from the Sunset to Turkey Hill phases.

An unusual site is a Yavapai-affiliated artifact scatter in the MM area that dates from approximately A.D. 1400 to 1863 and spans the poorly represented Protohistoric Period on the forest.

About one third of the sites in the analysis areas have at least one component that dates to the historic period, with most sites dating to the Statehood period (1912-1946). These sites include the remains of the Schultz Pass Civilian Conservation Corps (CCC) Camp, historic roads, logging railroad lines that represent the logging economy of the early 20th century (Clark Valley and Mormon Mountain RR lines), a ranching line shack, and temporary historic-period camps and trash dumps. There is one site with a historic-period inscription that dates to the Territorial Period (1863-1912).

Portions of the 86,000 acre San Francisco Peaks TCP are in the DLH area. The CNF has identified this TCP over many years of ongoing consultation with tribes about traditional locales. The San Francisco Peaks were determined eligible for the National Register under Criterion A for their cultural significance to the Acoma, Apache, Havasupai, Hopi, Hualapai, Navajo, Paiute, Yavapai, and Zuni people. This determination of eligibility came about as part of the settlement for the White Vulcan Mine (Pilles 2000). Although a formal boundary for the TCP has not been presented to the National Register of Historic Places for concurrence, a working boundary for the TCP was agreed to in consultation with 13 tribes and the Arizona State Historic Preservation Officer. This working, provisional boundary is co-terminus with the boundary of the area withdrawn from mineral entry as part of the White Vulcan Mine settlement agreement, and captures the DLH portion of this proposed project (Haines and Peters 2013: 14).

Johnson (2013) documents tribal consultation efforts for this project. So far, there haven’t been any responses from tribes regarding effects to the TCP from these alternatives.

All existing sites in the project area have the potential to increase the knowledge of human activities through various lines of research as well as assist in the interpretation of past human activities on the historic use of FWPP area to the public.

All NRHP eligible or unevaluated sites were evaluated for current conditions, research potential and tolerance to prescribed fire activities. At this time, 31 sites are managed as eligible or unevaluated to the NRHP and have some element that can potentially lead to further research and understanding of past human use of the area. Three sites are previously determined Not Eligible for inclusion to the National Register of Historic Places (NRHP) and we are recommending five sites identified during survey undertaken for the current analysis as Not Eligible to the NRHP. Of the thirty-one NRHP eligible or unevaluated sites, we have determined twenty-six sites to be fire tolerant (meaning that 26 of the 31 NRHP eligible or unevaluated properties can be burned in a light to moderate intensity prescribed fire without adverse effects). The fire intolerant sites consist of flammable materials within their boundaries and should be excluded from prescribed fire actions.

Desired Condition

Heritage resources are protected and managed on the Coconino National Forest as mandated by the 1966 National Historic Preservation Act, as amended (NHPA), 36 CFR 800, Forest Service Manual 2360, American Indian Religious Freedom Act, Archaeological Resource Protection Act and the National Environmental Policy Act (NEPA). We also follow the Region 3 First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities, and the Forest Plan, as amended.

The archaeological resources in the project area have moderate to high levels of both live and dead fuels present in and around them. Mechanical thinning and prescribed burning around all sites, with burning within fire tolerant sites as well as hand thinning within some sites, could assist in reducing the threat of fire damage and associated suppression actions to these resources for the next 10-20 years. With expected future maintenance prescribed burning, these sites could be protected indefinitely from catastrophic wildfires.

The desired condition for heritage resources within the FWPP is to inventory properties within the analysis area, reduce fuel loading in and around all eligible or unevaluated historic properties and protect them from adverse effects resulting from project implementation activities, as well as hazards from catastrophic fire and flooding. This strategy would assist in the preservation of site integrity, retain integrity of fire sensitive components of sites, and limit the potential for emergency fire suppression ground disturbing actions. Such a strategy ensures the future research and interpretation potential for these irreplaceable historic resources.

If additional TCPs are identified through tribal consultation on the Flagstaff Watershed Protection Project, all efforts would be made to reduce risk to the integrity of TCPs from catastrophic fire and flooding, improve conditions for plant gathering, and improve the health of TCPs, as perceived by practitioners. More details on efforts to protect and enhance conditions at TCPs have been submitted in a separate report on tribal consultation (Johnson 2013).

Spatial and Temporal Context for Effects Analysis

We analyzed project activities in both the short and long term for this project. We also considered not just heritage sites in the analysis area but also heritage sites immediately adjacent to the project area for those that could be affected by proposed activities. Rather than consider the effects of the proposal and each action alternative separately, we combined direct, indirect, and cumulative effects analysis where appropriate.

Past, Present, and Foreseeable Activities Relevant to Cumulative Effects Analysis

The most closely related project or proposal relative to the Flagstaff Watershed Protection Project is the Four Forests Restoration Initiative (4FRI). Although the projects have different aims, the associated activities are similar in that fuels would be reduced and prescribed fire would be returned to the ecosystem.

Other nearby projects and activities considered in the cumulative effects for this project include the ongoing Wing Mountain Fuels Reduction Project, special use events, the Fort Valley motorized trails, recreation use in the Dry Lake Hills area, hunter access and use, dispersed recreation, fuel wood gathering, the Mormon Mountain Communications Site, FH3 Tree Clearing Project, and future implementation of the Travel Management Rule. We also analyzed cumulative effects relative to past nearby projects and events, such as the 2010 Schultz Fire, the 1977 Radio Fire, Schultz Reforestation, Schultz Sediment Reduction, Arizona Trail Construction, grazing on the Peaks Allotment, past implementation of the Travel Management Rule, the Mormon Lake Fuels Reduction Project, thinning around forest communication towers from 2007-2008, and grazing on the Tinny Springs and Pickett Lake/Padre Canyon Allotments.

Environmental Effects

Alternative 1: No Action

Direct & Indirect Effects

Existing fuels in and around archaeological sites would remain as they are and continue to increase. No action would result in an increase in fuels and in high intensity wildfires that these properties have not been subjected to in the past. This situation would be exacerbated by the effects of climate change which include warming temperatures. Sites would be exposed to intense heat which would damage artifacts and features. Since the project areas lie within wildland urban interface (WUI) areas, an increase in wildfires would lead to an increase in aggressive wildfire suppression actions and an increase in the possibility of damage to resources during suppression events. More wildfire suppression tactics would also lead to more subsurface artifact and feature damage. Fire suppression actions, particularly bulldozer operations, may damage or completely destroy surface and subsurface heritage resources resulting in the loss of those resources and their associated data. This would affect their eligibility for the National Register of Historic Places (NRHP). Catastrophic wildfire in the area may also impact the San Francisco Peaks TCP, altering important characteristics of the property. Effects would be short and long term (Deal 1999, 2001, and 2012; Jackson 1998; Oster et al, 2012; Rude and Jones 2012; Ryan et al. 2012).

Over time, fuels would continue to increase in and around archaeological sites, which would keep them out of the visibility of public users, a beneficial effect. However, as stated above, increased fuels would have a long term negative cumulative effect if a wildfire burned over these sites because the sites would burn hotter and longer than expected in a managed, controlled burn setting.

Indirect effects from No Action would be an increase in erosion following a severe and catastrophic wildfire. An increase in erosion following a large wildfire would also lead to an increase in subsurface artifact and feature damage and a loss of artifact and provenience data.

Cumulative Effects

Fuel loading in and around project area sites as they are today has the potential to contribute to adverse effects on heritage resources from a large-scale wildfire. Effects would occur from extensive heat during the wildfire, ground disturbing actions during emergency wildfire suppression actions on all sites, and post-fire erosion and flooding (Ryan et al. 2012: 11-14). No action would also result in an increase in fuels, catastrophic wildfire, and suppression actions that could potentially impact portions of the San Francisco Peaks TCP in the analysis area. These areas would also be affected by erosion following a catastrophic wildfire event. No action would potentially lead to impacts that would severely damage the significance of the property.

Alternatives 2, 3 and 4

Direct & Indirect Effects

Alternatives 2, 3, and 4 are handled collectively as we anticipate direct, indirect, and cumulative effects would be very similar. Heritage sites would be avoided by all ground-disturbing activities (including traditional ground-based logging equipment as well as cable logging and helicopter harvesting on steep slopes), and fire-sensitive sites would be protected from broadcast fire activities. In addition, fuels would also be reduced via hand falling within sites, to further improve and stabilize them. All activities would have No Adverse Effect to sites.

Historic properties are highly vulnerable to the effects from authorized and unauthorized project activities as well as from the less tangible effects of benign neglect. Relevant issues emerging in heritage program management include not just site avoidance, but also the improvement of conditions at archaeological sites so that the sites are less vulnerable to the devastating effects of large scale wildfire (Haines and Lyndon 2010).

Recent research analyzing the post-wildfire condition of sites that were previously avoided by thinning and prescribed fire activities (Lutes 2014) demonstrates that when sites are avoided and their fuels are not managed, these sites burn much hotter than their counterparts where the unnatural buildup of on-site fuels has been reduced. The situation is critical on national forests such as the Coconino, with a large and complex number of heritage resources. Thus activities such as low to moderate broadcast prescribed fire across archaeological sites and hand thinning within sites, would have a beneficial effect at individual sites and can help improve watersheds on a landscape scale.

Short Term Effects

Sites would not be adversely affected in either the short or long term per protection measures in the First Amended Region 3 Programmatic Agreement (PA) (US Forest Service 2003 and 2010). Fire intolerant sites will be excluded from prescribed burning and all sites eligible to or unevaluated for the NRHP would be avoided by mechanical ground disturbing activities. There are some short term effects of the project on heritage sites which may make them more visible (through tree cutting in the immediate vicinity) and temporarily reduce their ground cover (following broadcast fire). On-site soils should remain stable during and after project activities, however, and the loss of ground cover at sites would be minimal and temporary. Additionally, ground cover would recover more quickly after a low intensity prescribed fire than after a high intensity wildfire, making the re-introduction of fire on the landscape under low to moderate conditions highly desirable for resource management. There could be an increase in visibility and possibly vandalism resulting from loss of ground cover can be mitigated through archaeological monitoring, public education, and law enforcement patrols.

There is a possibility of increased visibility and/or vandalism issue for archaeological properties if the project is implemented, especially in areas with high overlapping recreational use, as in the DLH area. Much of the project area is used by local residents for recreation and the reduction of ground cover through thinning and burning has the potential to increase site visibility and vandalism issues. This situation can be mitigated through the measures previously identified.

Long term Effects

The long term benefit to sites from fuels reduction far outweighs any short term effects, as long-term adverse effects to heritage sites from large-scale wildfire can be extreme (Deal 1999, 2001, and 2012; Jackson 1998; Oster et al, 2012; Rude and Jones 2012; Ryan et al. 2012). Prescribed broadcast burning within fire tolerant archaeological sites would improve long term conditions at those sites as managers return fire to the ponderosa pine forests in the analysis areas. The return of fire to the landscape in order to reduce on-site fuels would reduce potential impacts to sites from climate change, such as rising temperatures and an increase in catastrophic wildfires on the landscape.

Project activities authorized by the proposal and action alternatives would be designed to have No Adverse Effect and even improve the long term condition at heritage sites in the analysis area. This is due to the reduction of fuels at heritage sites and a decrease in likelihood that they would be adversely affected by extensive heat damage during a high intensity wildfire, or significantly affected by wildfire suppression tactics or post-fire flooding after project implementation.

If the proposal or any action alternatives are implemented, there would be fewer emergency fire suppression activities and the potential for ground disturbing activities like bulldozer fire-line construction would be reduced in the future. This would lead to greater protection of National Register eligible heritage resources per the 1966 National Historic Preservation Act as amended, the Region 3 Programmatic Agreement, and the 1987 Coconino National Forest Plan. In addition, Erosion from high intensity fire through soil sterilization and complete loss of ground cover would be reduced through selective thinning and low intensity burning that would leave large portions of the existing ground cover intact.

Cumulative Effects

Since many of the 4FRI project areas are near to FWPP project areas, those fuels reduction and landscape restoration activities would have a beneficial long term effect to archaeological sites, which would contribute to better overall forest health and archaeological sites that are less susceptible to the direct and indirect effects of large-scale wildfire. This project and 4FRI fuels reduction may also have a beneficial effect on springs in the San Francisco Mountain TCP, as has been demonstrated through collaborative forest restoration on the nearby Kaibab National Forest (Weintraub et al. 2013) which has enhanced and improved tradition locales for tribal members.

Cumulative effects from the action alternatives are anticipated to be minimal and can be reduced and/or mitigated through appropriate actions for this and other fuels reduction and watershed protection projects on the forest. There would be no change in the current status or treatment of archaeological sites resulting from the project. If the action alternatives are implemented, there would be a reduced need for emergency suppression actions, and in the unlikely event that suppression actions are necessary, they would be minimal after treatment.

Cumulative Effects Summary

All forest authorized activities, including but not limited to recreation use, grazing, and fuels reduction projects, are designed to have No Effect or No Adverse Effect to heritage sites. The action alternatives, when considered together with current and past projects, as well activities that will take place in the reasonably foreseeable future, would also have No Adverse Effect to sites. Sites unevaluated to or eligible for the NRHP would be avoided by all ground-disturbing activities, and would be enhanced through the application of broadcast prescribed fire, if they are not fire sensitive per the Region 3 PA (US Forest Service 2003).

As the action alternatives are designed to improve conditions at archaeological sites through the reduction of fuels, they would have a beneficial effect to the condition and long-term stewardship of heritage sites. Thus, the cumulative effect of this project, even relative to activities that are not authorized by the forest, such as the 1977 Radio Fire and future wildfires, would be to significantly improve the condition of sites.

Effects of the Forest Plan Amendments Proposed for Alternatives 2, 3 and 4

An analysis of the two proposed forest plan amendments was also completed. Proposed amendments include an amendment to use the revised Mexican Spotted Owl (MSO) recovery plan direction and one to remove the restriction of only using mechanical equipment on slopes less than 40 percent. The MSO amendment doesn’t have the potential to affect heritage sites. The amendment removing the 40 percent slope restriction for mechanical equipment will have No Adverse Effect to sites due to the extremely low potential for encountering archaeological resources in these locales. This is justified by current management direction in the Region 3 PA (2003) where heritage surveys are not required over 40 percent, owing to the low likelihood of sites.

Chapter 4. Consultation and Coordination

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TRIBES

Fort McDowell Yavapai Nation
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The Nature Conservancy
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Chapter 5. References

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Glossary

Active Crown Fire – A fire in which a solid flame develops in the crowns of trees, but the surface and crown phases advance as a linked unit dependent on each other.

Age Class – A distinct aggregation (grouping) of trees originating from a single natural event commonly consisting of trees of similar age.

Basal Area (BA) – the cross-sectional area of all trees, measured in square feet per acre.

Biomass – Multiple definitions include: organic matter produced by plants and other photosynthetic organisms; total dry weight of all living organisms that can be supported at each level of a food chain or web; dry weight of all organic matter in plants and animals in an ecosystem; plant materials and animal wastes that functions as fuel for fire.

Burn – An effect produced by heating. To undergo combustion, consuming fuel and giving off light, heat, and gasses. Also, an area where fire has occurred in the past.

Canopy – A layer of foliage, generally the uppermost layer, in a forest stand. Can be used to refer to midstory or ***understory*** vegetation in multi-layered stands.

Canopy Base Height (CBH) is a critical factor in crown fire initiation, and can be used as an indicator of the potential for crown fire initiation (Agee and Skinner 2005, Stratton 2009, Scott 2003). The desired condition is for CBH to be greater than 18 feet in ponderosa pine.

Canopy Bulk Density (CBD) – for ponderosa pine and pine-oak stands. CBD is a good indicator of potential active crown fire (Stratton 2009, Scott 2003). The desired condition is for average CBD to be less than 0.05 kg/m^3 in ponderosa pine.

Canopy Characteristics – Canopy characteristics include canopy cover, canopy base heights (CBH), and canopy bulk density (CBD) which contribute significantly towards the type of fire that can occur (Scott and Reinhardt 2001). Canopy cover, CBH, and CBD directly affect the incidence and behavior of crown fires and are used for modeling potential fire behavior (Scott 2003, Scott and Reinhardt 2005, Agee and Skinner 2005).

Canopy Cover – as used in modeling fire in the fire ecology analysis, canopy cover is the horizontal fraction of the ground that is covered directly overhead by tree canopy, the percent of vertically projected canopy cover in the stand (Scott and Reinhardt 2005). See the Forest Structure and Health section of Chapter 3 for details on how canopy cover was measured for this project.

Clean Water Act (CWA) – Act that provides the structure for regulating pollutant discharges to waters of the United States. The Act's objective is "…to restore and maintain the chemical, physical, and biological integrity of the Nation's waters," and is aimed at controlling both point and non-point sources of pollution. The U.S. EPA administers the Act, but many permitting, administrative, and enforcement functions are delegated to state governments. In Arizona, the designated agency for enforcement of the Clean Water Act is the Arizona Department of Environmental Quality (ADEQ).

Closed Road – Intermittent service roads that are closed to public vehicular traffic. However, these roads may be available and suitable for non-motorized uses. The closure period must exceed 1 year. Basic custodial maintenance is performed to keep damage to adjacent resources to an acceptable level and to perpetuate the road to facilitate future management activities. Emphasis is normally given to maintaining drainage facilities and runoff patterns. Planned road deterioration may occur at this maintenance level (USDA Forest Service 2005).

Clump – A tight cluster of two to five trees of similar age and size originating from a common rooting zone that typically lean away from each other when mature. A clump is relatively isolated from other clumps or trees within a group of trees. A stand-alone clump of trees can function as a tree group.

Condition Class (reference FRCC**)** – A measure of departure from reference conditions that can be used to determine how 'at risk' key ecosystem components are in the event of a disturbance event, such as fire.

Conditional Crown Fire – A crown fire that is dependent on ladder fuels in adjacent stands in order for fire to access the crowns. In an area with conditional crown fire, ladder fuels are insufficient in a stand for crown fire to initiate, but canopy fuels are sufficient to support crown fire if it moves in from an adjacent stand.

Controlled Burn – Synonymous with prescribed fire.

Coarse Woody Debris (CWD) – woody debris larger than 7.5 cm (3 inches) in diameter (Graham et al. 1994).

Cover Type – Refers to a forest or woodland type, such as ponderosa pine, pine-oak, or mixed-conifer.

Crown fire – A fire that advances from top to top of trees or shrubs more or less independent of a surface fire. Crown fires are sometimes classed as independent, conditional, or dependent (active or passive) to distinguish the degree of independence from the surface fire. Crown fires are common in coniferous forests and chaparral shrublands.

Declining – The senescent (aging) period in the lifespan of plants that (for trees) includes the presence of large dead and/or dying limbs, snag-tops, large, old lightning scars, and other characteristics that indicate the later life-stages.

Density-Related Mortality – Based upon established forest density/vigor relationships, density-related mortality begins to occur once the forest reaches 45 to 50 percent of maximum stand density, and mortality is likely at density levels over 60 percent of maximum stand density (Long 1985).

Diameter at Breast Height (dbh) – A standard measure of tree diameter measured approximately 1.5 meters (4.5 feet) above the ground.

Disturbance – Any relatively discrete event or series of events, either natural or human-induced that causes a change in the existing condition of an ecosystem, community, or population structure and alters the physical environment.

Disturbance Regime – A set of recurring conditions due to a variety of disturbances (e.g., fire, flooding, insect outbreak) and their interaction, which characterize an ecosystem within a historic, natural, or human induced context, within a given climate. This set of recurring conditions includes a specific range for each of the attributes of these disturbances. These attributes include: frequency, rotation period, intensity, severity, seasonality, patch size and distribution, residual structure, causal agent, the relative influence of each causal agent, and how they interact (Suffling and Perera 2004). The attributes researchers choose to represent a regime will vary depending on a researcher's area of interest (Sousa 1984, Pickett & White 1985, Agee 1993, Skinner and Chang 1996, Turner et al. 2001). An accurate description of a disturbance regime must include the full range of disturbance events, including those that are rare.

Diversity – The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan.

Drought – Periods of abnormally dry weather sufficiently long enough to cause a serious hydrological imbalance. Drought is a relative term; therefore, any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, there may be a shortage of precipitation during the growing season resulting in crop damage (agricultural drought), or during the winter runoff and percolation season affecting water supplies (hydrological drought).

Duff – The fermentation and humus layer lying below the litter layer and above mineral soil; consisting of partially decomposed organic matter whose origins can still be visually determined, as well as the fully decomposed humus layer. This layer does not include the freshly cast material in the litter layer, nor in the post-burn-environment ash (Brown 2000). The top of the duff is where needles, leaves, fruits, and other castoff vegetative material have noticeably begun to decompose. Individual particles usually are bound by fungal mycelia. The bottom of the duff is mineral soil. There is a gradient, not a clear division between litter and duff.

Ecological Restoration – The process of assisting the recovery of resilience and adaptive capacity of ecosystems that have been degraded, damaged, or destroyed. Restoration focuses on establishing the composition, structure, pattern, and ecological processes necessary to make terrestrial and aquatic ecosystems sustainable, resilient, and healthy under current and future conditions (USDA Forest Service 2008).

Environmental Justice – The fair treatment and involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. The White House, with Executive Order 12898, elevated environmental justice issues to the federal agency policy agenda. EO 12898 instructs each federal agency to identify and address "disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations" (Clinton 1994).

Ephemeral Stream – A stream that flows only briefly during and following a period of rainfall in the immediate locality.

Erosion – The wearing away of the land surface by rain or irrigation water, wind, ice, or other natural or anthropogenic agents that abrade, detach, and remove geologic parent material or soil from one point on the earth's surface and deposit it elsewhere.

Even-aged Stand – A stand of trees composed of a single age class in which the range of tree ages is usually plus or minus 20 percent of rotation (SAF 2008).

Even-aged Management – The application of a combination of actions that result in the creation of stands in which trees of essentially the same age grow together. Managed even-aged forests are characterized by a distribution of stands of varying ages (and, therefore, tree sizes) throughout the forest area. The difference in age between trees forming the main canopy level of a stand usually does not exceed 20 percent of the age of the stand at harvest rotation age. Regeneration in a particular stand is obtained during a short period at or near the time that a stand has reached the desired age or size for regeneration and is harvested. Clearcut, shelterwood, or seed tree cutting methods produce even-aged stands.

Fire Adapted Ecosystem – An associated group of plant and animals that have made long-term genetic changes in response to the presence of fire in their environment.

Fire Ecology – The study of fire’s interaction with ecosystems.

Fire Hazard – A fuel complex defined by volume, type, condition, arrangement, and location that determines the degree of ease of ignition and the resistance to control. Fire hazard expresses the potential fire behavior for a fuel type, regardless of the fuel type’s weather-influenced fuel moisture content (Hardy 2005).

Fireline Intensity – Rate of heat release in the flaming front.

Fire Regime – A set of recurring fire conditions that characterize an ecosystem, within a historic, natural, or human induced context, within a given climate. This set of recurring conditions includes a specific range of attributes. Sugihara et al. (2006) use the following attributes: seasonality, frequency (fire return interval), intensity, severity, size, spatial complexity, and fire type. An accurate description of a fire regime will include the full range of fire events, including those that are rare and connect to the larger disturbance regime which contains the fire regime as a subset. There are five fire regimes:

Fire regime I – 0 to 35 year frequency and low (surface fires most common, isolated torching can occur) to mixed severity (less than 75 percent of dominant overstory vegetation replaced)

Fire regime II – 0 to 35 year frequency and high severity (greater than 75 percent of dominant overstory vegetation replaced)

Fire regime III – 35 to 100 year frequency and low/mixed severity

Fire regime IV – 35 to 100 year frequency and high severity

Fire regime V – 100+ year frequency and high severity.

Fire Regime Condition Class (FRCC) – An ecological evaluation protocol that uses three classes for describing the relative degree of departure from historical fire regimes.

Fire Return Interval – The number of years between two successive fires in a designated area (i.e., the interval between two successive fires); the size of the area must be clearly specified (McPherson and others 1990).

Fire Risk – In the context of technical risk assessments, the term "risk" considers not only the probability of an event, but also includes values and expected losses. Within wildland fire, 'risk' refers only to the probability of ignition (both man- and lightning-caused) (Hardy 2005).

Fire Type – Flaming front patterns that are characteristic of a fire.

First Order Fire Effects – Effects resulting directly from the fire, such as fuel consumption and smoke production.

Forage – Browse and herbage which is available and can provide food for animals or be harvested for feeding; or to search for, or consume, forage (ITR 1734-4).

Forbs – A broadleaved, herbaceous plant (e.g., columbine).

Forest Health – The perceived condition of a forest derived from concerns about such factors as its age, structure, composition, function, vigor, presence of unusual levels of insects or disease, and resilience to disturbance. Note perception and interpretation of forest health are influenced by individual and cultural viewpoints, land management objectives, spatial and temporal scales, the relative health of the stands that comprise the forest, and the appearance of the forest at a point in time (SAF 2008).

Fuel Loads – The amount of combustible material present per unit area.

Group – A cluster of two or more trees with interlocking or nearly interlocking crowns at maturity surrounded by an opening. The size of tree groups is typically variable depending on forest community and site conditions and can range from fractions of an acre (a two-tree group) to many acres. Trees within groups are typically non-uniformly spaced, some of which may be tightly clumped (SAF 2008).

Group Selection – A cutting procedure which creates a new age class by removing trees in groups or patches to allow seedlings to become established in the new opening (SAF 1998).

Habitat: place where an animal or plant normally lives, often characterized by a dominant plant form or physical characteristic. Often described for individual species, e.g., spotted owl habitat, it is usually used as a generalization of where an animal may live (Fire Ecology Report 2013).

Heritage Strategy – A strategy developed in consultation with the Arizona State Historic Preservation Officer to assist in reaching a "No Adverse Effect" determination for the project (see heritage specialist report).

Heterogeneity – For the purposes of this analysis, heterogeneity refers to having bio-diversity in terms of habitat and forest structure across the landscape.

Historic Range of Variation (HRV) – Refers to ecosystem composition, structure, and process for a specified area and time period. Historic range of variation (HRV) is often used to determine our best estimate of "natural" conditions and functions, and thus is often our best estimate of the natural range of variation (NRV). Ecosystems change over time. It is assumed that native species have adapted over thousands of years to natural change and that change outside of NRV may affect composition and distribution of species and their persistence (4FRI Fire Ecology Report 2013).

Hydrologic Condition – The current state of the processes controlling the yield, timing, and quality of water in a watershed (FSM 2521.05).

Impaired Waters – Under section 303(d) of the 1972 Clean Water Act, states, territories, and authorized tribes are required to develop lists of impaired waters. These impaired waters do not meet water quality standards that states, territories, and authorized tribes have set for them, even after point sources of pollution have installed the minimum required levels of pollution control technology. The law requires that these jurisdictions establish priority rankings for waters on the lists and develop TMDLs for these waters. See the water quality and riparian specialist report for additional information.

Invasive – any species which can establish, persist, and spread in an area, and be detrimental or destructive to native ecosystems, habitats, or species and difficult to control or eradicate.

Ladder Fuel – Fuel, such as branches, shrubs, or an understory layer of trees, which allow a fire to spread from the ground to the canopy.

Landscape-Scale – A spatial scale and extent expressed in geographic terms within which to target action, e.g., projects aimed at forest landscape restoration. In this analysis, the landscape scale for vegetation is the ponderosa pine extent.

Large Tree – A large tree as defined in the revised Mexican Spotted Owl Recovery Plan (USDI 2012) is a tree greater than 18-inch dbh.

Litter – The top layer of the forest, shrubland, or grassland floor above the duff layer, including freshly fallen leaves, needles, bark, flakes, fruits (e.g., acorns, cones), cone scales, dead matted grass, and a variety of accumulated dead organic matter which is unaltered, or only slightly decomposed. This layer typically does not include twigs and larger stems. One rough measure to distinguish litter from duff is that you can pick up a piece of litter and tell what it was (a leaf or leaf part, a needle, etc.). Duff is generally not identifiable. There is a gradient, not a clear division between litter and duff.

LOPFA – Landscapes outside of goshawk post-fledging family areas as referenced in the Forest Plan.

Management Area – The mission, goals, and objectives for the forest are realized by applying groups of management activities to specific units of land. Groups of management activities are called “prescriptions" and the land units are called "management areas."

Mature Tree –A tree that has attained most of its potential height growth.

Mechanical Treatment – Any activity (e.g., silvicultural thinning, biomass removal) performed by human-controlled tools (e.g., chainsaw, feller-buncher) that results in the removal or alteration of wood fiber. Does not include the use of fire.

Mexican spotted owl habitat – Three levels of habitat management are described in the Recovery Plan: protected areas, restricted (recovery) areas; and other forest and woodland types.

Monitoring – A systematic process of collecting and storing data related to natural systems at specific locations and times. Determining a system's status at various points in time yields information on trends, which is crucial in detecting changes in systems.

Mosaic – The spatial arrangement of habitat where there is stand heterogeneity, measured at many spatial scales from the patch, the stand, and the vegetative community.

Native species – a species which is an indigenous (originating where it is found) member of a biotic community. The term implies that humans were not involved in the dispersal or colonization of the species.

Nest/Roost Recovery Habitat – Areas managed to replace nest/roost habitat lost to disturbance or senescence and to provide new nest/roost habitat for a recovering owl population (USDI 2012).

Non-market Values – The benefits and values associated with National Forests that do not have a monetary price including clean water and air, biodiversity, forest products, and other goods and services. Also referred to as "ecosystem services."

Nutrient Cycling (Soil) – The circulation of chemicals necessary for life, from the environment (mostly from soil and water) through organisms and back to the environment.

Old Growth – The last stage in forest succession. Old-growth habitat is the sum of the physical and biological components of old-growth forest that are essential to maintaining populations of certain old growth dependent species of wildlife.

Old Growth Protection and Large Tree Retention Strategy (OGP and LTRS) – Strategy developed by the 4FRI stakeholders in 2010 (finalized in 2011), which provides recommendations relating to the retention of large post-settlement and old growth trees.

Passive Crown Fire – A fire in the crowns of the trees in which trees or groups of trees torch, ignited by the passing front of the fire. The torching trees reinforce the spread rate, but these fires are not basically different from surface fires.

Patch - a small part of a stand or forest (see also "group"); an area of vegetation, that is relatively homogeneous internally and differs from surrounding elements (SAF 2008)

PFA – Goshawk post-fledging family area as referenced in the Coconino Forest Plan.

Pile Burning – Activity fuels, once piled by machine or by hand, are burned in place.

Planned Ignition – The intentional initiation of a wildland fire by hand-held, mechanical, or aerial device where the distance and timing between ignition lines or points and the sequence of igniting them is determined by environmental conditions (weather, fuel, topography), firing technique, and other factors which influence fire behavior and fire effects (see prescribed fire).

Pre-Commercial Thinning – The removal of trees not for immediate financial return but to reduce stocking to concentrate growth on the more desirable trees (SAF 2008).

Prescribed Fire – A wildland fire originating from a planned ignition to meet specific objectives identified in a written, approved, prescribed fire plan for which NEPA requirements (where applicable) have been met prior to ignition (see planned ignition).

Properly Functioning Condition (PFC) – A methodology for assessing the physical functioning of riparian and wetland areas. The term PFC is used to describe both the assessment process, and a defined, on-the-ground condition of a riparian-wetland area (National Riparian Service Team Definition, 2013).

Protected Habitat (Mexican Spotted Owl) – Protected habitat consists of protected activity centers (PACs) and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas. The primary objective for protected habitat is the protection of the best available habitat for Mexican spotted owls while retaining management flexibility to abate high fire risk and to improve habitat conditions for the owl and its prey.

Proposed Action – In terms of the National Environmental Policy Act, the project, activity, or action that a Federal agency intends to implement or undertake (Coconino NF Forest Plan Glossary).

Recovery Unit – A specific geographic area, identified mainly from physiographic provinces, used to evaluate the status of Mexican spotted owls and within which to develop specific management guidelines (USDI 2012). The recovery unit specific to this analysis is the Upper Gila Mountain Recovery Unit (RU), also referred to as the UGMRU.

Recreational Opportunity Spectrum (ROS) – A classification system that describes different outdoor recreation settings across the forests using seven standard classes that range from primitive, undeveloped settings to urban, highly developed settings. Attributes typically considered in describing the settings are size, scenic quality, type, and degree of access, remoteness, level of development, social encounters, and the amount of on-site management. See the recreation and scenery report for additional information.

Reference Condition (also referred to as Historic Reference Condition) – A range of conditions (found in the present or the past) against which the effects of past and future actions can be compared. These states can provide an explicit, historically-based context for comparing different management effects. Examples include periods before fire suppression or the arrival of an invasive species, or a similar but "healthier" modern ecosystem. Ideally, these environmental conditions are based on functioning ecosystems where natural ecosystem structure, composition, and function are operating with limited human intervention (very minor human-caused ecological effects).

Regenerate – The act of renewing tree cover by establishing young trees naturally or artificially (SAF 2008).

Residence Time – Time required for the flaming front of a fire to pass a stationary point at the surface of the fuel. The length of time the flaming front occupies one point; relates to downward heating and fire effects below the surface.

Resiliency – The capacity of a (plant) community or ecosystem to maintain or regain normal function and development following disturbance (SAF 2008).

Resource Protection Measures – Measures (design features or mitigation) implemented to minimize nonpoint source pollution as outlined in the intergovernmental agreement between the Arizona Department of Environmental Quality and the Southwestern Region of the Forest Service (ADEQ 2008).

Recovery Habitat (Mexican Spotted Owl) - Recovery habitat is ponderosa pine-Gambel oak habitat that does not meet the definitions of protected habitat, i.e., there are no known resident Mexican spotted owls, and is not considered a reserved land (e.g., designated wilderness, research natural areas, etc.). The objective in recovery habitat is to manage the landscape to maintain and create replacement owl habitat where appropriate while providing a diversity of stand conditions and stand sizes across the landscape.

Riparian Area – Riparian ecosystems are distinguished by the presence of free water within the common rooting depth of native perennial plants during at least a portion of the growing season. Riparian ecosystems are normally associated with seeps, springs, streams, marshes, ponds, or lakes. The potential vegetation of these areas commonly includes a mixture of water (aquatic) and land (phreatic) ecosystems (Coconino NF Forest Plan Glossary).

Road Decommission – Activities that result in the stabilization and restoration of unneeded roads to a more natural state (36 CFR 212.1, FSM 7705—Transportation System, USDA 2003). FSM 7712.11- Exhibit 01 identifies five levels of treatments for road decommissioning which can achieve the intent of the definition. These include blocking the entrance, revegetation waterbarring, removing fills and culverts, establishing drainageways and removing unstable road shoulders, and full obliteration, recontouring, and restoring natural slopes.

Road Reconstruction and Improvement – Any activity that results in an increase of an existing road’s traffic service level, expansion of its capacity, or a change in its original design function. Activities include, but are not limited to, the construction of bridges and major culverts, placing bar ditches, subgrade repairs, shoulder widening, lane widening, ditch widening, roadway prism widening, horizontal and vertical alignment changes, curve widening, and improving site distance at road intersections. Vegetation would likely be removed with these activities.

Road (Route) Obliteration – See road decommission.

Road Realignment – Activity that results in a new location of an existing road or portions of an existing road and treatment of the old roadway. Generally, realignments are for the purpose of moving the road location to a more suitable area to mitigate impacts to streams, critical wildlife habitat, and other natural or cultural resources. Often, reconstruction is used interchangeably with road relocation. This activity includes creating a new road alignment in an upland position, installing the proper drainage features, signage, and surfacing on the new road alignment and the decommissioning of the old road alignment. The new road alignment would require the removal of vegetation at the new alignment site.

Scenery Management Systems (SMS) – Guidance developed by the Forest Service for managing scenery and determining the relative value and importance of scenery in the national forest (also see VMS and the scenery specialist report for additional information).

Severity – The quality or state of distress inflicted by a force. The degree of environmental change caused by a disturbance (e.g., fire).

Scenic Integrity Objectives (SIO) – Scenic Integrity or "intactness" of national forest lands is the means by which proposed alterations to the land are evaluated. Scenic Integrity is produced from the combined inventory of scenic attractiveness, viewing distance from the observer, and concern level of forest visitors. SIOs are established for the forest and can be applied at the forest, management area or treatment area (USDA-Forest Service 2000). SIOs range from Very High, meaning the landscape character is unaltered, to Very Low, meaning the landscape character is highly altered. Intermediate levels include High (landscape character appears unaltered), Moderate (landscape character is slightly altered), and Low (landscape character is moderately altered). Another basic premise of the SMS is landscape character, which gives a geographic area its visual and cultural image. It consists of a combination of physical, biological and cultural attributes that make each landscape identifiable and unique. Landscape character embodies distinct landscape attributes that exist throughout an area (Forest Service 2000).

Slash – The residue left on the ground after timber harvest or as a result of storms, fire, girdling, or poisoning. Slash includes unused logs, uprooted stumps, broken or uprooted stems and the heavier branchwood, lighter tops, twigs, leaves, bark, and chips.

Snag – Standing dead tree from which the leaves or needles have fallen.

Soil Function – The characteristic physical and biological activity of soils that influences productivity, capability, and resiliency (FSM 2521.05).

Soil Productivity – The capacity of soil, in its normal environment, to support plant growth.

(Soil) Tolerance – The point beyond which there is high risk that potential may be permanently altered or impaired through changes in specified physical, chemical, and biological factors brought about by management activities or natural events (FSM 2521.05).

Spatial Pattern – Arrangement of forested areas and openings on the landscape.

Spring – In this analysis, springs are natural water features that existed prior to Euro-American settlement and were probably functional due to lack of human disturbances (USDA 2009).

Stand – A contiguous area of trees sufficiently uniform in forest type, composition, structure, and age class distribution, growing on a site of sufficiently uniform conditions to be a distinguishable unit. Four classification characteristics are generally used to distinguish forest stands: bio-physical site (soils, aspect, elevation, plant community association, climate, etc.), species composition, structure (density, and age (1-aged, 2-aged, uneven-aged)), and management emphasis (administrative requirements and local management emphasis that will shape structure over time). Based upon agency guidelines, the minimum stand mapping size is 10 acres.

Stand Density – A measure of the degree of crowding of trees within stocked areas commonly expressed by various growing space ratios (e.g., height/spacing) (SAF 2008).

Stand Density Index (SDI) – A measure of the stocking of a stand of trees based on the number of trees per unit area and diameter at breast height (dbh) of the tree of average basal area. It may also be defined as the degree of crowding within stocked areas, using various growing space ratios based on crown length or diameter, tree height or diameter, and spacing. The computed value of SDI is often compared to the species maximum to determine the relative "stand density" or stocking of the stand.

Stand Structure – The horizontal and vertical distribution of components of a forest stand including the height, diameter, crown layers, and stems of trees, shrubs, herbaceous understory, snags, and down woody debris (SAF 2008).

State Historic Preservation Office (SHPO) – The state office responsible for consultation and assistance regarding the presence and significance of cultural resources in a project area, efforts needed to find and evaluate them, whether the project will cause harmful effects to the cultural resource, and how to reduce or avoid the harm.

Stratum/Strata (plural) – A layer of soil with internally consistent characteristics that distinguish it from other layers.

Surface Fire – A fire that burns over the forest floor, consuming litter, killing aboveground parts of herbaceous plants and shrubs, and typically scorching the bases and crowns of trees. See also backing fire, crown fire, fire, flanking fire, ground fire, head fire, and understory fire.

Surface Fuel – Fuels lying on or near the surface of the ground, consisting of leaf and needle litter, dead branch material, downed logs, bark, tree cones, and low stature living plants. See also duff, fuel, large woody debris, and litter.

Target habitat -- a category of Mexican spotted owl recovery habitat intended to provide future nesting and roosting habitat (see definition for recovery habitat). A variety of forest structural attributes is used to define nesting and roosting habitat (summarized in table III.B.1 of the Recovery Plan and table C-2 of the draft Recovery Plan). The minimum values identified for the forest attributes represent the threshold for meeting nesting and roosting conditions (see the definition for threshold habitat). They can also be targets to be achieved with time and management. If less than 10 percent of the restricted habitat in ponderosa pine-Gambel oak qualifies as threshold habitat, the areas that can eventually achieve all threshold conditions simultaneously should be identified as *target habitat* and managed to achieve threshold conditions as rapidly as possible. Because no known Mexican spotted owl nests or roosts occur in restricted habitat, target habitat is considered future nesting and roosting habitat.

Temporary Road or Trail – A road or trail necessary for emergency operations or authorized by contract, permit, lease, or other written authorization that is not a forest road or trail and that is not included in a forest transportation atlas (36 CFR 212).

Threatened and Endangered Species – Species identified by the Secretary of Interior in accordance with the 1973 Endangered Species Act, as amended. See the wildlife report for additional information.

Threshold habitat - a category of Mexican spotted owl recovery habitat intended to provide for future nesting and roosting habitat (see definition for recovery habitat). A variety of forest structural attributes is used to define when nesting and roosting habitat is achieved (summarized in table III.B.1 of the Recovery Plan and table C-2 of the draft Recovery Plan). These values are targets that can be achieved with time and management (see definition for target habitat). When the minimum values identified for the forest attributes are met simultaneously, they represent the *threshold* of nesting and roosting conditions. Ten percent of restricted habitat in ponderosa pine-Gambel oak should be designated as threshold habitat. Management in threshold habitat cannot lower any of the forest attribute values below the nesting and roosting threshold unless a landscape analysis demonstrates an abundance of this habitat. Because no known Mexican spotted owl nests or roosts occur in restricted habitat, target habitat is managed as future nesting and roosting habitat.

Total Maximum Daily Load (TMDL) – A written analysis that determines the maximum amount of a pollutant that a surface water can assimilate (the “load”), and still attain water quality standards during all conditions. The TMDL allocates the loading capacity of the surface water to point sources and nonpoint sources identified in the watershed, accounting for natural background levels and seasonal variation, with an allocation set aside as a margin of safety. See the Soil and Water Resources specialist report for additional information.

Torching – See passive crown fire.

Traditional Cultural Property (TCP) – Traditional use areas and places that have been used by cultural groups over generations. Natural springs are also considered TCPs and/or sacred sites by some tribes. Many plants are gathered for ceremonial on or near TCPs.

Travel Management Rule (TMR) – On December 9, 2005, the Forest Service published the TMR. The agency rewrote direction for motor vehicle use on National Forest Service lands under 36 CFR, Parts 212, 251, and 261, and eliminated 36 CFR 295. The rule was written to address at least in part the issue of unmanaged recreation. The rule provides guidance to the Forest Service on how to designate and manage motorized recreation on the Forests. The rule requires each National Forest and Grassland to designate those roads, motorized trails, and areas that are open to motor vehicle use.

Trees Per Acre (TPA) – a count of the total number of trees on an acre.

Unauthorized Road – A road that is not a forest road or a temporary road or trail and that is not included in a forest transportation atlas (36 CFR 212).

Understory – The trees and other woody species growing under a more or less continuous cover of branches and foliage formed collectively by the upper portion of adjacent trees and other woody growth. In this analysis, the term understory is also referred to as "herbaceous understory."

Uneven-aged Forests – Forests that are comprised of three or more distinct age classes of trees, either intimately mixed or in small groups.

Uneven-aged Management – The application of a combination of actions needed to simultaneously maintain continuous high-forest cover, recurring regeneration of desirable species, and the orderly growth and development of trees through a range of diameter or age classes (to provide a sustained yield of forest products). Cutting is usually regulated by specifying the number or proportion of trees of particular sizes to retain within each area, thereby maintaining a planned distribution of size classes. Cutting methods that develop and maintain uneven-aged stands are single-tree selection and group selection.

Vegetation Structural Stage (VSS) – A method of describing forest age and tree size from seedling to old forests. The VSS classification is based on the tree size class with the highest square foot of basal area and is an indication of the dominant tree diameter distribution (see Forest Health and Structure section for details).

Visual Management System (VMS) – The VMS was used to develop Visual Quality Objectives (VQOs) that are prescribed in the forest plan for all lands within the CNF. The VQO classifications range from Preservation, Retention, Partial Retention, Modification, to Maximum Modification. The VMS process has been updated in the Scenery Management System (SMS). See the scenery report for additional information.

Watershed – The area that contributes water to a drainage or stream (Coconino NF Forest Plan, Glossary).

Watershed Condition – The state of a watershed based upon physical and biological characteristics and processes affecting hydrologic and soil functions (FSM 2521.05).

Watershed Condition Framework – A framework established by the Forest Service that provides a new consistent, comparable, and credible process for improving the health of watersheds on national forests and grasslands. The framework includes a technical guide which provides protocol for assessing watershed condition across all 193 million acres of National Forest System lands (http://www.fs.fed.us/publications/watershed).

Water Quality – See Clean Water Act

Water Yield – The total net amount of water produced including streamflow and groundwater Recharge (Coconino NF Forest Plan Glossary).

Wildland Fire – A general term describing any non-structure fire that occurs in the wildland.

Wildland Urban Interface (WUI) – The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation fuels. WUI areas are spread across the project area and are located within or adjacent to the communities of Flagstaff.

Woody Debris – The dead and downed material on the forest floor consisting of fallen tree trunks and branches.

Appendix A – Forest Plan Amendments

The following Forest Plan amendments are being done under the 2012 Planning Rule per 36 CFR 219.17 (b)(2), which requires all Forest Plan amendments initiated after May 9, 2012 to utilize the 2012 Planning Rule.

Amendment 1

The purpose of this amendment would be to facilitate treatment in high-priority locations such as Mexican spotted owl occupied habitat to prevent high-severity wildfire from removing nest/roost habitat. This is based on language in the Mexican Spotted Owl Recovery Plan (2012), which states, "[wildfires] result in the most significant alteration of owl habitat and hence, have the greatest potential for loss of habitat" (USDI 2012). Amendment 1 is a specific, one-time variance for managing MSO habitat in the FWPP project area. Once the project is complete, current Forest Plan direction would apply to the project area. The language proposed does not apply to any other forest project.

Amendment 1 Description

Amendment 1 would update the terminology referring to MSO habitat types to reflect that of the 2012 MSO Recovery Plan. Specifically, this amendment would update the definition of protected habitat to exclude pine-oak and mixed conifer forests with slopes greater than 40 percent where timber harvest has not occurred in the last 20 years and instead including these areas as recovery habitat, and change "restricted" habitat to "recovery" habitat.

This amendment would allow mechanical thinning within PACs and restricted habitat to reduce the risk of high-severity wildfire. Amendment 1 would change the treatment diameter limit of 9 inches dbh to 18 inches dbh in ten MSO PACs[43], and would allow the removal of larger trees (greater than 18 inches dbh in PACs and 24 inches dbh in recovery habitat) for cable corridor locations under Alternative 2 only.

Amendment 1 would also allow hand thinning in the Schultz Creek nest core up to 5 inches dbh, and prescribed burning treatments within all MSO nest cores. The amendment would remove language referencing monitoring (pre- and post-treatment, population, and habitat); replacement language would defer to a monitoring plan developed specifically for this project by the Forest Service, U.S. Fish and Wildlife Service (FWS), and the Ecological Restoration Institute of Northern Arizona University. The monitoring plan is included in this document as Appendix B, and includes the details for sample selection, treatment specifics, measurement protocols including timing, and planned analyses. The proposed monitoring plan would also pair treated and untreated (reference) PACs within the Dry Lake Hills and Mormon Mountain portions of the project and compare occupancy rates, reproduction rates, and habitat changes. Reference PACs would match the environmental conditions in PACs where treatments are proposed, as closely as possible. The monitoring plan would be finalized in conjunction with FWS consultation.

The amendment would allow the MSO nest roost recovery area identified within the project area to be treated to meet the minimum habitat requirements for MSO nest roost recovery habitat under the 2012 revised MSO Recovery Plan.

[43] Ten PACs within the FWPP boundary: De Toro's, Lockwood, Moore Well, Mormon Mountain, Mormon Mountain North, Weimer Springs, Schultz Creek, Mount Elden, Orion Spring, and Weatherford 2

Amendment 1 would also remove timing restrictions on treatments within ten MSO PACs for two breeding seasons in order to more quickly accomplish implementation and to limit the duration of impacts to MSO. Treatments would be prioritized to be accomplished within one to two breeding seasons, and would be coordinated with FWS. No one PAC would be treated for more than two breeding seasons. If treatments within a PAC extend beyond the two year timeframe, timing restrictions would apply for the subsequent years (March 1 – August 31).

Timing restrictions would still apply for activities in nest cores, including hand thinning within the Schultz Creek nest core and prescribed burning within all nest cores.

Need for Plan Amendment

MSO PAC field reviews, data evaluation, and vegetation simulation modeling indicate that there is a need to mechanically thin trees greater than 9 inches dbh in ten PACs and greater than 24 inches dbh in recovery habitat within the project boundary in order to facilitate treatments to achieve the purpose and need of the FWPP project: to reduce the risk of high-intensity wildfire and subsequent flooding.

There is a need to treat within MSO nest/cores to remove fuels and reduce the risk of ecologically-damaging wildfire as leaving these areas untreated would not meet the purpose and need, and could also hinder the feasibility of prescribed burning in PACs. Lining the core areas would be expensive in terms of time, money, and other resource commitments, and would still leave these areas vulnerable to high-intensity wildfire. There is a need to treat MSO nest roost recovery habitat to meet the minimum habitat requirements for MSO nest roost recovery habitat under the 2012 revised MSO Recovery Plan due to the existing forest structure and to put that habitat on a trajectory toward desired conditions.

There is a need to replace the monitoring language specified in the Forest Plan in order to better incorporate a monitoring plan tiered to the revised MSO Recovery Plan (USFWS 2012) and developed by the Forest Service, the Fish and Wildlife Service, and the Ecological Restoration Institute of Northern Arizona University. Monitoring assesses the effectiveness of management actions and provides the adaptive framework needed to develop successful management by assisting in determining the effects of thinning and burning on Mexican spotted owls and their habitat. The monitoring plan will be reviewed as part of the consultation process for treatments planned to occur within PACs.

Edited or added/new text is **bolded** in Table 167. Current Forest Plan direction related to MSO that would not be changed under this amendment is not included below.

Table 167: Amendment 1: Current and Proposed MSO Forest Plan Language

Current Forest Plan Direction	Proposed New Standard or Guideline Language for FWPP
MSO Standards	
No corresponding direction currently exists.	**The Flagstaff Watershed Protection Project will comply with the biological opinion and monitoring protocol developed in consultation with the FWS.**
Provide three levels of habitat management – protected, restricted, and other forest and woodland types to achieve a diversity of habitat conditions across the landscape (p. 65).	Provide three levels of habitat management – protected, **recovery**, and other forest and woodland types to achieve a diversity of habitat conditions across the landscape (p. 65).
Protected areas include delineated protected activity centers; mixed conifer and pine-oak	**Within the Flagstaff Watershed Protection Project boundary, protected areas include**

Current Forest Plan Direction	Proposed New Standard or Guideline Language for FWPP
forests with slopes greater than 40% where timber harvest has not occurred in the last 20 years; and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas (Coconino NF Forest Plan, p. 65)**.**	**delineated protected activity centers; and reserved lands which include wilderness, research natural areas, wild and scenic rivers, and congressionally recognized wilderness study areas. Recovery habitat includes pine-oak and mixed conifer forests on all slopes (Coconino NF Forest Plan, p. 65).**
Limit human activity in protected activity centers during the breeding season (Coconino NF Forest Plan, p. 65).	Limit human activity in protected activity centers during the breeding season, **except for the following PACs where implementation of treatments may occur the Flagstaff Watershed Protection Project boundary for no more than two breeding seasons: De Toro's, Lockwood, Moore Well, Mormon Mountain, Mormon Mountain North, Weimer Springs, Schultz Creek, Mount Elden, Orion Spring, and Weatherford 2.**
In protected and restricted areas, when activities conducted in conformance with these standards and guidelines may adversely affect other threatened, endangered, or sensitive species or may conflict with other established recovery plans or conservation agreements; consult with US Fish and Wildlife Service to resolve the conflict (Coconino NF Forest Plan, p. 65-1).	In protected and **recovery** areas, when activities conducted in conformance with these standards and guidelines may adversely affect other threatened, endangered, or sensitive species or may conflict with other established recovery plans or conservation agreements; consult with US Fish and Wildlife Service to resolve the conflict (Coconino NF Forest Plan, p. 65-1).
Monitor changes in owl populations and habitat needed for delisting (Coconino National Forest Plan, page 65-1).	**Monitoring of owl populations and habitat within the Flagstaff Watershed Protection Project boundary will follow the monitoring protocol developed and finalized through that project's consultation with the US Fish and Wildlife Service.**
MSO Guidelines	
Harvest fuelwood when it can be done in such a way that effects on the owl are minimized. Manage within the following limitations to minimize effects on the owl (Coconino NF Forest Plan, p. 65-2). Retain key forest species such as oak. Retain key habitat components such as snags and large downed logs. Harvest conifers less than 9 inches in diameter only within those protected activity centers treated to abate fire risk as described below,	Harvest fuelwood when it can be done in such a way that effects on the owl are minimized. Manage within the following limitations to minimize effects on the owl (Coconino NF Forest Plan, p. 65-2). Retain key forest species such as oak. Retain key habitat components such as snags and large downed logs. Harvest conifers less than 9 inches in diameter only within those protected activity centers treated to abate fire risk as described below,

Current Forest Plan Direction	Proposed New Standard or Guideline Language for FWPP
except for the Clark PAC where trees less than 16 inches diameter will be harvested.	except for the Clark PAC where trees less than 16 inches diameter will be harvested **and the following PACs within the Flagstaff Watershed Protection Project boundary, where trees up to 18 inches dbh will be harvested: De Toro's, Lockwood, Moore Well, Mormon Mountain, Mormon Mountain North, Weimer Springs, Schultz Creek, Mount Elden, Orion Spring, and Weatherford 2 PACS. Where cable logging occurs, all trees may be removed within cable logging corridors, including those above 18 inches in PACs and above 24 inches in recovery habitat.**
Treat fuel accumulations to abate fire risk. –Select for treatment 10% of the protected activity centers where nest sites are known in each recovery unit having high fire risk conditions. Also select another 10% of the protected activity centers where nest sites are known as a paired sample to serve as control areas (Coconino National Forest Plan, page 65-2). –Designate a 100 acre "no treatment" area around the known nest site of each selected protected activity center. Habitat in the no treatment area should be as similar as possible in structure and composition as that found in the activity center. –Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area.	Treat fuel accumulations to abate fire risk. –Select for treatment 10% of the protected activity centers where nest sites are known in each recovery unit having high fire risk conditions. Also select another 10% of the protected activity centers where nest sites are known as a paired sample to serve as control areas (Coconino National Forest Plan, page 65-2). –Designate a 100 acre "no treatment" area around the known nest site of each selected protected activity center. Habitat in the no treatment area should be as similar as possible in structure and composition as that found in the activity center. **Within the Flagstaff Watershed Protection Project boundary, allow prescribed hand thinning of trees less than 5 inches dbh in 80% of the Schultz Creek nest core and prescribed burning in the following nest cores within the project boundary outside of the MSO breeding season: De Toro's, Lockwood, Moore Well, Mormon Mountain, Mormon Mountain North, Weimer Springs, Schultz Creek, Mount Elden, Orion Spring, and Weatherford 2.** –Use combinations of thinning trees less than 9 inches in diameter (or less than 16 inches in the Clark PAC), mechanical fuel treatment and prescribed fire to abate fire risk in the remainder of the selected protected activity center outside the 100 acre "no treatment" area except as follows:

Current Forest Plan Direction	Proposed New Standard or Guideline Language for FWPP
	Use combinations of thinning trees up to 18 inches dbh within : De Toro's, Lockwood, Moore Well, Mormon Mountain, Mormon Mountain North, Weimer Springs, Schultz Creek, Mount Elden, Orion Spring, and Weatherford 2 PACs, mechanical fuel treatment and prescribed fire to abate fire in the remainder of the selected protected activity center outside the 100-acre **nest core** area.
Treat fuel accumulations to abate fire risk. Pre and post treatment monitoring should be conducted in all protected activity centers treated for fire risk abatement. (See monitoring guidelines) (Coconino National Forest Plan, page 65-2).	**Monitoring of owl populations and habitat within the Flagstaff Watershed Protection Project boundary will follow the monitoring protocol developed and finalized through that project's consultation with the US Fish and Wildlife Service.**
Mixed Conifer and Pine-oak Forests (See glossary definition): Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species. The following table displays the minimum percentage of restricted area which should be managed to have nest/roost characteristics. The minimum mixed conifer restricted area includes 10% at 170 basal area and an additional amount of area at 150 basal area. The additional area of 150 basal area is +10% in BR-E and +15% in all other recovery units. The variables are for stand averages and are minimum threshold values and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum threshold values should be reduced below the threshold values unless a district-wide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the district-wide or larger landscape analysis shows there is a surplus. This table has been modified	Mixed Conifer and Pine-oak Forests (See glossary definition): Manage to ensure a sustained level of owl nest/roost habitat well distributed across the landscape. Create replacement owl nest/roost habitat where appropriate while providing a diversity of stand conditions across the landscape to ensure habitat for a diversity of prey species. **Nest roost recovery habitat in the Flagstaff Watershed Protection Project would be treated to meet or exceed the minimum habitat requirements for MSO nest roost recovery habitat under table C3 in the 2012 revised MSO Recovery Plan**. The variables are for stand averages, are minimum threshold **habita**t values, and must be met simultaneously. In project design, no stands simultaneously meeting or exceeding the minimum **nest roost recovery habita**t values should be reduced below threshold values unless a district-wide or larger landscape analysis of restricted areas shows that there is a surplus of restricted area acres simultaneously meeting threshold values. Management should be designed to create minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the district-wide or larger landscape analysis shows there is a surplus of restricted area acres simultaneously meeting the threshold values. Management should be designed to create

Current Forest Plan Direction	Proposed New Standard or Guideline Language for FWPP
to contain only information pertinent to the Coconino NF. (Coconino NF Forest Plan, pp.65-3 to 65-5).	minimum threshold conditions on project areas where there is a deficit of stands simultaneously meeting minimum threshold conditions unless the district-wide or larger landscape analysis shows there is a surplus. This table has been modified to contain only information pertinent to the Coconino NF. (Coconino NF Forest Plan, pp.65-3 to 65-5).

Amendment 2

Amendment 2 Description

Amendment 2 would remove language restricting mechanical equipment to slopes less than 40 percent and language identifying slopes above 40 percent as inoperable. This amendment would allow mechanical harvesting on slopes greater than 40 percent within the project area.

Need for Plan Amendment

It would be necessary to allow for use of specialized mechanical equipment to cut and remove trees on steep slopes to reduce the risk of high-severity wildfire in this project area due to the preponderance of areas with greater than 40 percent slope in the project area. Furthermore, since the Forest Plan was written and amended, mechanized ground-based equipment has progressed to be able to operate on steep slopes more effectively. While this specialized equipment is not commonplace in this region due to the high cost of its use, the approval of the City bond makes the use of such equipment a possibility for this project. In order to be able to utilize such equipment to treat slopes above 40 percent in the project area and meet the purpose and need, this Forest Plan amendment is needed.

Edited or added/new text is **bolded** in Table 168.

Table 168: Amendment 2: Current and Proposed Steep Slope Forest Plan Language

Current Forest Plan Direction	Proposed New Standard or Guideline Language for FWPP
Inoperable Lands: Timber lands, usually greater than 40 percent slope, not meeting the Forest cable logging criteria. See Operable Lands for criteria definition (p. 252).	Inoperable Lands: Timber lands, usually greater than 40 percent slope, not meeting the Forest cable logging criteria **and outside of the Flagstaff Watershed Protection Project boundary**. See Operable Lands for criteria definition.
Operable Lands: Timbered lands, usually 40 percent slope and greater, meeting the forest cable logging criteria. The cable logging criteria are: cut per acre must be 3 MMBF[44] or greater;	Operable Lands: Timbered lands, usually 40 percent slope and greater, meeting the forest cable logging criteria **or within the Flagstaff Watershed Protection Project boundary**.

[44] MMBF (million board feet): A symbol to indicate one million board feet of wood fiber volume either in log form or after conversion to lumber (Forest Plan, p. 256)

Current Forest Plan Direction	Proposed New Standard or Guideline Language for FWPP
maximum yarding distance not to exceed 1,300 feet (slope distance); volume from contiguous cable logging area must be at least 1 MMBF; sale area must also contain a minimum of 1 MMBF of conventional logging volume, or no less than a 50-50 mix; multi-span yarding is not required, and cable yarding areas must be 300 to 400 acres in size to meet the cut per acre and 1 MMBF requirement (p. 258).	The cable logging criteria **for areas outside of the Flagstaff Watershed Protection Project** are: cut per acre must be 3 MMBF or greater; maximum yarding distance not to exceed 1,300 feet (slope distance); volume from contiguous cable logging area must be at least 1 MMBF; sale area must also contain a minimum of 1 MMBF of conventional logging volume, or no less than a 50-50 mix; multi-span yarding is not required, and cable yarding areas must be 300 to 400 acres in size to meet the cut per acre and 1 MMBF requirement. **Within the Flagstaff Watershed Protection Project area, harvesting activities are not confined by the cable logging criteria above, but rather are defined by that project's NEPA analysis and decision.**

Appendix B – Monitoring Protocols

Proposed Mexican Spotted Owl Monitoring

As part of the Flagstaff Watershed Protection Project (FWPP), fuels reduction and prescribed burning activities will occur within Mexican spotted owl protected activity centers (PACs). Protected activity centers are occupied habitat. The effects of these treatments to owls and nesting/roosting habitat are not fully known. The Mexican spotted owl Recovery Team thinks that PACs can be afforded substantial protection by emphasizing fuels reduction and forest restoration in surrounding areas outside of PACs and nest/roost habitat, it is recognized that in some cases protection of nest/roost habitat and human communities requires these action to occur within PACs. The Mexican spotted owl Recovery Plan, First Revision (USFWS 2012) provides guidance for these treatments and emphasizes the need for monitoring and feedback loops to allow management to be adaptive. Well-designed monitoring will provide valuable information on the effects of these activities on the owls and their habitat. Therefore, the Forest Service is working with the U.S. Fish and Wildlife Service (FWS) and Rocky Mountain Research Station (RMRS) to propose a monitoring plan that should help us begin to understand the effects of thinning and burning on Mexican spotted owls and their habitat.

The proposed monitoring plan would pair treated and untreated (reference) PACs within the Dry Lake Hills (n=3) and Mormon Mountain (n=3) portions of the project and compare occupancy rates, reproduction rates, and habitat changes.

Guiding Question:

- Do planned treatments (e.g., thinning, prescribed fire) affect occupancy and reproductive rates in treated versus untreated PACs?

Identified Response Variables:

- Owl occupancy rate (corrected for detection probability; the percent of PACs occupied before and after treatments).

- Owl reproductive output (the number of fledgings observed per adequately checked pair before and after treatments).

- Habitat change (the immediate effect of a treatment type on key variables selected from Table C.1 (USDI 2012, pp 276-277) showing description of desired conditions [DCs]) in forest and woodland cover types typically used by Mexican spotted owls for nesting and roosting. Analysis would incorporate what is retained as well as extent of change.

Planned Treatments:

- Treatments will likely be variable in spatial extent and intensity (intensity measured by degree of change in key habitat variables related to DCs [see Table C.1]).

General Study Design Approach:

- For each treatment area (DLH and MM) monitoring will contrast a set of reference PACs (with no planned treatments) to a set of treatment PACs. Reference PACs match the environmental conditions in PACs where treatments are proposed, as closely as possible.
    - For the DLH project area treatments are proposed for the entire PAC in three PACs: Mt. Elden (040202), Schultz Creek (040206), and Orion Spring (040207). Additionally, treatments are proposed in a portion (163 acres) of the Weatherford 2 PAC (040239). Orion will not be considered as a treatment PAC for monitoring due to current and past activities in the PAC that have affected owls. Three reference PACs are: Snowbowl (040205), Little Spring (040227), and East Bear Jaw (040233).
    - For the Mormon Mountain project area treatments are proposed for the entire PAC in three PACs: Mormon Mountain North (040508), Weimer Springs (040532), and Detoros (040533). Additionally, portions of Mormon Mountain (040551), Lockwood (040541) and Moore Well (Rock Dike) (040511) overlap with the project area (149, 148, and 20 acres respectively). Treatment PACs will be those with the entire PAC treated. Since the proposed areas for treatment are predominately mixed conifer, controls need to be similar. Reference PACs are: Dairy Spring (040507), Red Raspberry (040503) and Moore Well (Rock Dike) (040511). Moore Well overlaps with the project area however, treatments would need to occur later in time.
- Establish and install long-term forest monitoring plots in treated PACS in FWPP area and untreated PACs outside of FWPP.
    - There are four treatment types proposed in PACs: Burn Only, MSO PAC Fuels Reduction Mixed Conifer, MSO PAC Fuels Reduction Hand Thinning and MSO Nest Fuels Reduction. Sampling will be stratified by treatment type with long-tern fixed plots randomly located within treatment types.
    - Long-term fixed plots will be randomly located in reference PACs where treatments are not proposed.
- Measure habitat change to calibrate treatments effects using the following desired condition variables (Table C.1):
    - Methods Outline (all sites):
        1. Establish and install long-term forest monitoring plots in treated PACs in FWPP area and untreated PACs outside of FWPP:

        a. Sampling stratified by treatment type (~ 1 plot per 22 ac (9 ha)).

        b. Long-term, fixed plots randomly located within treatment types within PACs.

        c. Nested circular plot sampling; trees and shrubs:

            i. Standing dead trees (snags) = 0.20-ac (8712 ft2) (0.08 ha).

            ii. Live trees ≥ 4.5 ft height = 0.10-ac (4356 ft2) (0.04 ha).

iii. Shrubs and trees < 4.5 ft height = 0.025=ac (1076 ft2) (0.01 ha).

d. Fuels/coarse wood transects (x 2):

i. 50 ft length:

1. Moisture-lag classes (<0.25 in; .25-1.0 in; 1.0-3.0 in. +3 in. (sound/rotten).

2. Diameter/length/location all +3 in. CWD.

e. Canopy cover:

i. 50-ft line intercept (x 2).

- Sample response variables for owls each year, using a design that allows estimation of effects to occupancy, detection probability, reproductive output,

    - Monitor treatment and reference PACs using the Mexican Spotted Owl Survey Protocol U.S. Fish and Wildlife Service, 2012.

- Sample timing
    - PAC monitoring will be completed one year pre-treatment, during treatment year, and one, three and five years post-treatment.
    - Vegetation Sampling will be completed prior to treatments (as close as possible prior to implementation), one and five years post-treatment.

Analytic Approach:

- Simple treatment effect stratified by treatment type and geographic area/cover type.

Quality Control / Assurance:

- Vegetation monitoring has already begun in the DLH portion of the project and information/lessons learned will be used to inform the monitoring for MM. Any changes will be developed with FWS and modified as appropriate.

Red Squirrel Monitoring Plan

Red Squirrel Monitoring Proposal

Prepared by: Arizona Game and Fish Department

Purpose and Need

The Flagstaff Watershed Protection Project (FWPP) is a cooperative effort between the City of Flagstaff, US Forest Service, and the State of Arizona to treat 15,000 acres. The primary purpose of the FWPP is to reduce the risk of high severity wildfire and subsequent flooding in two key watersheds around Flagstaff, Arizona: in the Dry lake Hills portion of the Rio de Flag Watershed, and the Mormon Mountain portion of the Upper Lake Mary Watershed. Treatments will include traditional logging, hand thinning, prescribed fire, helicopter logging, and cable logging.

Red squirrels (*Tamiasciurus hudsonicus*) are primarily associated with mixed conifer forest in the Southwest. The red squirrel is a Management Indicator Species for the Coconino National Forest. Red squirrels play an important role in forest ecology and restoration, as they are excellent indicators of changes as a result of forest treatments. Red squirrels require a forest structure that provides large areas of closed canopy and large trees that produce an abundant cone crop.

More information is needed on the red squirrel's distribution and abundance, their habitat associations, population trends, and how they are impacted by forest management practices. Previous research has shown that the mean density of red squirrels was higher in the spruce-fir stands compared to white fir (*Abies concolor*) and Douglas fir (*Pseudotsuga menziesii*) stands (Frey 2003). Red squirrels are also more likely to occur in stands where ponderosa pine does not occur (Frey 2003). By locating and monitoring middens, we can identify the characteristics that define the juxtaposition of middens and their surrounding forest structure and describe the spatial arrangement of resources that define suitable habitat for red squirrels. In addition, monitoring midden activity can provide a conservative estimate of squirrel populations (Frey 2003) since one squirrel typically maintains and defends one primary midden. Both male and female red squirrels defend exclusive territories centered on the midden (Frey 2003). While midden counts have been used to estimate population sizes in small drainages or areas (Wolff and Zasada 1975), no study to date has done so for larger watersheds.

Objectives

The objectives of this project are to: 1) determine the abundance of active (as defined below) red squirrel middens on the Coconino National Forest in the FWPP, 2) identify characteristics (e.g., forest structure, trees per hectare, prescription type) of red squirrel middens 3) characterize long-term population trends, and 4) record the possible effects that various forest restoration treatments may have on red squirrel populations.

Study Sites

The Dry Lake Hills study area within FWPP encompasses 3,063 ha of land in a watershed that feeds water down to Flagstaff, Arizona. It is situated in the San Francisco Mountains north of Flagstaff in the Coconino National Forest. We will focus efforts solely within the Dry Lake Hills portion of FWPP (Figure 1). While our current plans do not include work in the Mormon Mountain section of the FWPP, we may expand surveys to that area if it is deemed necessary or desirable in the future. Existing conditions within the Dry Lake Hills project area include stands with numerous dog-hair thickets on steep slopes with high fire risk and a substantial wildland-urban interface.

Cover types in the project area include ponderosa pine, aspen (*Populus tremuloides*), dry mixed conifer, wet mixed conifer, Gambel's oak (*Quercus gambelli*), woodland, and grassland. There is also significant departure from historic vegetation conditions and fire return intervals within most of the project area. In general, fire regimes in the analysis area have shifted from more frequent, lower-intensity surface fires historically to less frequent, higher-intensity crown fires in recent years. This departure has created conditions where, if a wildfire were to occur, there would likely be more severe impacts to ecosystem components (e.g., trees, soil, wildlife) than would have occurred under more historical and natural fire regimes. Given this departure from past conditions, there is a greater need to reduce the risk of fire and post-fire flooding that threatens to damage the drinking water infrastructure south of Flagstaff, and which could also cause extensive damage to residential and commercial areas should a high-intensity wildfire occur in mountainous areas that make up the Upper Lake Mary and Rio de Flag watersheds (see USFS Proposed Action).

In cooperation with the USFS and the USFWS, the Ecological Restoration Institute (ERI) at Northern Arizona University (NAU) established 169 long-term, fixed monitoring plots in the FWPP area during the spring of 2014. The long term plots were stratified by treatment type, with ~ 1 plot per 9 ha of habitat within each of 3 treatment types (i.e., logging, hand thinning, and prescribed fire) and a control (untreated). The ERI placed 78 in control plots and 91 located in treated plots.

Species Studied/Impacted

We will document red squirrel middens on the ground. No handling of live wildlife will be required. We will not conduct surveys during the Mexican Spotted Owl (*Stirx occidentalis*) breeding season (1 March to 31 August) to minimize disturbance to breeding pairs.

Methods

We will identify red squirrel middens on 169 long-term monitoring plots. We will collect pre treatment data related to middens in year 1 and post treatment data in year 2, depending on when treatments occur. We will record data on each midden (e.g., size, age, activity, and location). Midden size will include an assessment of whether the midden is a large primary midden or a smaller satellite midden. In the case of a satellite midden, the associated primary midden has to be found in order to verify the satellite status of the observed midden. Age of the midden will be assessed by observing the relative state of decay of the midden material. In newly constructed middens, the midden material is fluffy and not compacted or decayed (Fluffy stage). As a midden ages, the midden material becomes compacted (Compacted stage) and eventually begins to decay (Composted stage). Compaction and decay begin at the bottom of the midden. Activity of the midden will be assessed by observations of squirrels or sign. An active midden will be determined by the presence of a squirrel at the midden or by the presence of fresh cones or feeding remains at the midden. Fresh cone remains have bright coloration. Our partners at the ERI at NAU will quantify pre- and post-treatment forest structure and fuels characteristics in all the plots. They will also look at cover and vegetation type. Cover is the amount of overstory cover characterized by canopy cover and vegetation type is the US Forest Service description of vegetation type.

Analysis

Using the added habitat data collected by ERI, we will apply tests to determine if red squirrel midden density differs by cover or vegetation type. We will use the Kruskal- Wallis to test whether red squirrel midden density significantly differed by cover and vegetation type. Simple correlations will be assessed between red squirrel midden density estimates and each independent variable (mean density of Douglas fir, White Fir, Englemann spruce, downed logs, and total number of trees). Multiple regression including all independent variables will be used to assess the power with which all variables together predicted red squirrel midden density. Stepwise multiple regression will be used to assess the significance of each independent variable for predicting red squirrel midden density. We will also summarize mean tree density and size class (diameter at breast height) to characterize stand size structure of dominant conifer tree species across all red squirrel midden sampling plots pre- and post-treatment using habitat data collected by the ERI.

Because we will be visiting the middens pre and post-treatment, we anticipate that active squirrel middens will decrease post treatment due to the change in canopy cover.

Previous research (Patton and Vahle 1986) showed that few middens were found in areas without substantial overhead and side shade from tree cover. We also anticipate middens within areas that have received treatments will have an increased rate of decay post treatment due to the increased amount of sunshine hitting the ground due to reduced canopy cover and basal tree area.

Coordination: We will work closely with the ERI under agreement with Northern Arizona University Sub Award # 1002204-01. The ERI will be collecting forest structural data at the same sites, thus providing us a unique opportunity to supplement wildlife data with vegetation data related to monitoring plots and the effects of forest treatments. They will collect measurements of forest structure and characterize botanical and understory properties in 2014. We will also work closely with Shaula Hedwall of the USFWS to insure that we do not disturb MSO areas in critical breeding times. We will coordinate with Erin Phelps of the USFS for required clearance and access/permits/permission on the Coconino National Forest in northern Arizona.

Expected Results

Our expected results could help refine habitat relationship patterns in order to better direct forest management in ways that will benefit this species.

Fire & Fuels

MONITORING FOR PRESCRIBED FIRE

The purpose of this document is to outline the protocols and standards used by fuels and fire personnel to monitor the fire effects on ecosystem components within areas burned by prescribed fire on the Flagstaff Ranger District of the Coconino National Forest.

Specific protocols have been developed from a combination of the Firemon and FSVeg protocols and following the DRAFT Region 3 Vegetation Monitoring/Sampling Protocols (updated December 2008) included in this 3 ring binder. The forest characteristics that are measured pre and post fire/prescribed burn and prescribed fire protocols are described below in detail and include overstory trees, pole sized tree or saplings, seedlings, snags, fuel loading, and CBI (composite burn index which assessed burn severity) which is solely performed postfire and under special severe wildfire or prescribed fire situations. CBI methodology and protocols will only be implemented when the District Fuels Specialist deemed necessary.

Prescribed Fire monitoring- CBI plot monitoring would not be performed for prescribed fire unless the fuel specialist has deemed it necessary. The following criteria can help with making the decision: Prescribed burn is >1000 acres and/or a broad range of fire effects resulted from the burn.

- All hard copies of data sheets/data collected needs to be stored in the 3 ring monitoring binder for each project area. Data sheets and photos should be placed in sheet protectors. Protectors would help maintain sheets when they are taken out into the field for postburn monitoring.
- All data should be entered into FSVeg as soon as possible after monitoring has been completed (pre and post). Tessa Nicolet can help with teaching how to set up criteria for entering and accessing data in FSVeg database. A NRM FSVeg profile (roles established- I think Shawn Martin is the contact) will need to be established in order to input data into FSVeg.
- Quality assurance of data collected needs to be performed. This requires Fuels Crew leader visiting each plot and ensuring that data collected by crew members has met within error range indicated on data collection sheets.
  Error compared to plot checker: DBH (+ 0.2 in), Height (+ 2 ft), Crown Ratio (+ 5%), CBH (+ 1 ft)
  If plot checker finds many errors with the data, the plot needs to be remeasured. Any comments need to be made regarding differences in transect direction and/or plot center needs to regpsed using the averaging feature if the coordinates do not agree with actual location. These new coordinates need to be recorded on the data sheet and on plot location map.
- All pictures should be downloaded/saved onto the FS network drive as soon as possible after monitoring has been completed. Photos of plots preborn and postburn should also be printed out and placed in monitoring three-ring binder. Photos can be helpful in locating the plot especially if elk or other wildlife have ripped out rebar of the plot.

During burning:

- A FEMO/FOBs or someone who can spin weather/record weather observations and take pictures throughout the burn should be designated for every prescribed burn and during shifts when plots burn in a managed fire situation.
- These weather observations and during burning photos should be filed in the 3 ring monitoring folder for that particular project area.
- It is also ideal if a burn boss packet is placed in the during burning section of the 3 ring binder to keep track of any special circumstances or additional information that may be useful during analysis of the pre and post-burn data.

Soil and Water: Best Management Practices (BMP) Monitoring

A set of national BMP implementation and effectiveness monitoring protocols and forms for vegetation management would be used to conduct BMP monitoring during timber harvesting activities. Protocols and monitoring forms are available at: http://fsweb.wo.fs.fed.us/wfw/watershed/national_bmps/bmp_docs-vegetation.html.

Separate protocols and forms would be used for monitoring ground-based timber harvesting activities and cable/aerial (helicopter) yarding activities. Implementation monitoring is used to document that those design features identified for soils/watershed are being applied during timber harvest activities whereas effectiveness monitoring is used to determine whether design features are serving their intended purpose of protecting water quality. Implementation monitoring would likely be conducted prior to the onset of seasonal periods of precipitation (i.e., prior to the onset of the North American monsoon) whereas, effectiveness monitoring would occur during periods of precipitation.

Monitoring would be conducted by an interdisciplinary team with expertise in hydrology, soils, forestry, and timber harvesting. Results of monitoring would be used for adaptive management of BMPs such that any measures that are found to be ineffective in controlling non-point source pollution would be modified or replaced by measures that are effective.

Appendix C – Law, Regulation & Policy Compliance

Fire, Fuels and Air Quality

National Level Direction
Federal laws, regulations, and policies affecting this project include:

- Executive Order 13112; Invasive Species (64 FR 6183, February 8, 1999). The FWPP proposes ground disturbing activities, such as mechanical thinning, and prescribed fire which may provide opportunities for invasive species to become established. To comply with this Executive Order, FWPP would monitor populations within the treatment area, and restore native species and habitat conditions in areas that are invaded.

- Organic Administration Act, June 4, 1897 (16 U. S. C. 551). This act authorizes the Secretary of Agriculture to make provisions for the protection of national forests against destruction by fire. The treatments proposed by FWPP would support the intent of the Organic Administration Act by reducing the potential for undesirable fire behavior and effects.

- National Environmental Policy Act of 1970. Compliance with this act requires analysis of proposed actions. Proposed treatments include prescribed fire and mechanical treatments, so the analysis includes the effects of prescribed fire as well as the resulting emissions.

- Clean Air Act (CAA), as amended 1977 and 1990. This act provides for the protection and enhancement of national air resources by regulating air emissions from stationary and mobile sources. This law authorized EPA to establish National Ambient Air Quality Standards (NAAQS) to protect public health and welfare and to regulate emissions of hazardous air pollutants. NAAQS were established for specific pollutants emitted in significant quantities throughout the country that may be a danger to public health and welfare. If an area does not meet or "attain" the standards, it becomes a non-attainment area and must demonstrate to the public and the EPA how it will meet standards in the future via a State Implementation Plan (SIP). Section 112 of the CAA addresses emissions of hazardous air pollutants, including smoke from wildfires and prescribed fires. Section 160 of the CAA requires measures "to preserve, protect, and enhance the air quality…" in national parks, national wilderness areas, national monuments, and other areas of special national or regional natural, recreational, scenic, or historic value, some are classified as Class I attainment areas. Implementation of the CAA is largely the responsibility of the states which may develop programs that are more restrictive than the CAA requires but never less. The CAA mandates states have a SIP to regulate pollutants. The FWPP proposes using prescribed fire on 8,938 acres. To ensure compliance with the CAA, emissions from these acres were evaluated to determine the potential effects.

The "1995 Federal Wildland Fire Policy" is the principle document guiding fire management on Federal lands. The Policy was endorsed and implemented in 1995. The 1995 Federal Wildland Fire Policy was reviewed and updated in 2001 (Review and Update of the 1995 Federal Wildland Fire Management Policy, 2001). In 2003 the Interagency Strategy for the Implementation of Federal Wildland Fire Management Policy was approved. The 2003 Implementation Strategy was replaced in 2009 with the adoption of the Guidance for Implementation of Federal Wildland Fire

Management Policy which states that:

"Fire, as a critical natural process, will be integrated into land and resource management plans and activities on a landscape scale, and across agency boundaries. Response to wildland fire is based on ecological, social, and legal consequences of fire. The circumstances under which a fire occurs, and the likely consequences on firefighter and public safety and welfare, natural and cultural resources, and values to be protected dictate the appropriate management response to fire."

The FWPP is not intended to dictate the appropriate response to wildfires. Action alternatives should increase the decision space for Agency Administrators for how to managed lightning caused fires when they occur, while reducing the potential for undesirable fire behavior and effects. The effects of planned ignitions (prescribed fires) are discussed. This document provides direction, consistent with the Coconino Forest Plan regarding the use of planned ignitions in the proposed treatment area.

State Level Direction

Arizona Department of Environmental Quality (ADEQ) air quality regulations: Smoke produced by prescribed fires is subject to regulation by EPA regulations as enforced by the ADEQ. The State of Arizona has a State Implementation Plan that outlines how the State is implementing the goals of the Clean Air Act, and Statutes that regulate burning, including burning on Federal lands. Two types of air quality impacts are addressed by these laws and regulations: health hazards from pollutants, and potential visibility impacts in Class I Air Sheds.

The key policy resulting from the Enhanced Smoke Management Plan pertaining to prescribed burns in Arizona is Arizona Revised Statute Title 18 Chapter 2 Article 15. This law regulates fires managed on Federal and State lands, as well as on Tribal, private, and municipal jurisdictions where there is a Memorandum of Understanding with the Arizona Department of Environmental Quality (ADEQ). This Statute defines the request and approval process for all burns, and provides the mechanisms for tracking emissions from burns. Enforcement of this statute is facilitated by the Smoke Management Group, housed at ADEQ in the Air Quality Division. Prescribed fires implemented as treatments under the FWPP will be subject to these same regulatory policies and statutes and meet the Enhanced Smoke Management Plan. The State of Arizona has an Enhanced Smoke Management Plan (ESMP) that is consistent with the Western Regional Air Partnership (WRAP) Enhanced Smoke Management Programs for Visibility. The State of Arizona conducts annual meetings of all affected parties to discuss smoke management issues and objectives. This approach calls for programs to be based on the criteria of efficiency, economics, law, emission reduction opportunities, land management objectives, and reduction of visibility impacts. An Enhanced Smoke Management Plan (ESMP) comprises a series of key policies and management practices. In general the ESMP must specifically address visibility effects and apply to all fire sources as do all smoke management plans in the State of Arizona. The ESMP should also apply uniformly to source sectors or be tailored to source sectors and/or geographical areas. In addition, the ESMP must provide the opportunity to work collaboratively with state, tribal, local, and federal agencies, and private parties while considering the criteria of efficiency, economics, law, emission reduction opportunities, land management objectives, and reduction of visibility impact.

Problem or Nuisance Smoke is defined by the Environmental Protection Agency (EPA) as the amount of smoke in the ambient air that interferes with a right or privilege common to members of the public, including the use or enjoyment of public or private resources. While there are no laws or regulations governing nuisance smoke, it can limit opportunities of land managers to use fire. Public concerns regarding nuisance smoke often occur long before smoke exposures reach levels that violate NAAQS (Achtemeir et al. 2001). "Probably the most common air quality issues facing wildland fire managers are those related to public complaints about nuisance smoke...about the odor or soiling effects of smoke, poor visibility, and impaired ability to breathe or other health-related effects. Sometimes complaints come from the fact that some people don't like or are fearful of smoke intruding into their lives (Hardy et al. 2001b)." Prescribed fire treatments proposed though the action alternatives may result in an increase of Nuisance Smoke.

Agency Level Direction

USDA Forest Service

Forest Service Manual 5100 (page 9) includes direction on USFS use of prescribed fire to meet land and resource management goals and objectives. The objectives of fire management on lands managed by the USFS are:

1. Forest Service fire management activities shall always put human life as the single, overriding priority.

2. Forest Service fire management activities should result in safe, cost-effective fire management programs that protect, maintain, and enhance National Forest System lands, adjacent lands, and lands protected by the Forest Service under cooperative agreement.

Coconino National Forest Land & Resource Management Plan (Forest Plan)

Forest Plans provide specific goals, objectives, standards, and guidelines for management activities on National Forest lands. The Coconino National Forest (USDA 1987, as amended 2012) has developed forest-wide and location-specific standards and guidelines for reducing the risk of severe fire effects to resources.

The Forest Plan provides specific goals, objectives, standards, and guidelines for management activities on the Coconino National Forest. The forest-wide, management area (MA), or geographic area (GA) standards and guidelines have fire-related (management of or reduced risk to resources values from) relevance to this analysis. Directions for other resources aimed at reducing the risk of fire have been incorporated into this analysis as appropriate.

Forest Structure and Health

Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

Multiple-Use Sustained Yield Act of 1960. Requires that national forest lands shall be administered for a variety of multiple uses, and that all resources shall be maintained as renewable in perpetuity for regular periodic output of several products and services at a sustainable level.

National Environmental Policy Act of 1969 (NEPA). Established procedures for decision making, disclosure of effects, and public involvement on all major federal actions.

National Forest Management Act of 1976 (NFMA). The Coconino forest plan was developed in accordance with NFMA, as expressed by the 1982 planning rule.

While federal laws like the National Forest Management Act establish the regulatory requirements of forest management for federal agencies, the detailed direction that affects the project-level vegetation analysis being undertaken in this proposed action are contained in the forest plans for the Coconino National Forest (USDA 1987, as updated 2008). These include the goals, objectives, direction, and Forest-wide and Management Area standards and guidelines that have relevance to the proposed action.

Coconino National Forest Plan Management Areas

The project area includes 11 Management Areas (MA) as described in the Coconino NF forest plan (pp. 46 to 206-113). The two main management areas comprising the project include: Ponderosa pine and mixed conifer on less than 40 percent slopes (MA-03) makes up approximately 5,509 acres; and Ponderosa pine and mixed conifer on greater than 40 percent slopes (MA-04) makes up approximately 3,734 acres of the project area. The other management areas that are in the project area include: Aspen (MA-05) 91 acres; Unproductive Timber Land (MA-06) 672 acres; Pinon-Juniper Woodlands, greater than 40 percent slope (MA-08) 15 acres; Mountain Grasslands (MA-09) 46 acres; Grasslands and sparse Pinyon-Juniper Above the Rim (MA-10) 140 acres; Elden Environmental Study Area (MA-18) 278 acres; and Electronic Sites 28 acres. An additional 40 acres is classified as private lands which were formerly private but are now Forest Service land. In addition two additional management areas overlay the above listed management areas. In the Dry Lake Hills part of the project the Schultz management area (MA-36) overlays most of the project area. In the Mormon Mountain part of the project the Lake Mary Watershed Management Area (MA-35) also overlays most of this part of the project area.

Insect and Disease Management - Cuts are designed to eliminate or reduce dwarf mistletoe infections to manageable levels (CFP, page70).

Integrated Stand Management (ISM) - Establish and maintain stand diversity through ISM to provide suitable habitat for wildlife in lands suitable for timber production, while maintaining or enhancing timber resource production and timber age class distribution (CFP, page70).

Uneven-aged management will be emphasized (CFP, MA3, page 123).

Manage oak to improve wildlife habitat. Maintain oak components wherever they occur (CFP, MA3, page 131).

The alligator juniper component of the ponderosa pine is managed primarily for maintaining and enhancing wildlife habitat (CFP, MA3, page 132).

Reduce competition between closely spaced trees in some areas, to promote future large trees faster and to achieve desired tree sizes and canopy closures outlined in the Forest Plan (Mexican spotted owl and northern goshawk habitat guidelines) (CFP, FLEA, page 206-75).

Reduce competition between closely spaced trees in some areas to promote health and resistance to insects and disease (CFP, FLEA, page 206-75).

Table 12. Vegetation Management Practices for ponderosa pine, oak and aspen vegetation types as it applies to uneven-aged harvest systems , stand improvement thinning, intermediate thinning, and prescribed burning (CFP, page 242-19).

Region Wide Forest Plan Amendment

Forest vegetation management direction in the Coconino National Forest Land Management Plan (USDA 1987, as updated 2008) was amended in 1996 through a region-wide amendment of all forest plans in Arizona and New Mexico (USDA 1996).

Mexican Spotted Owl Recovery Plan

A revised Mexican spotted owl recovery plan was developed and signed by the US Fish and Wildlife Service in December of 2012. This project will be utilizing the management recommendations in the revised recovery plan.

Elements that relate to forest vegetation operations for the Mexican spotted owl include:

Provide habitat management for protected activity centers (PACs) and recovery habitat. Within PACs additional management consideration is given to the nest/roost core. Recovery habitat is classified into nest/roost and foraging/non-breeding. Recovery habitat includes all mixed-conifer, pine-oak, and riparian outside of PACs.

The revised MSO recovery plan identifies stand-replacing wildfires as the primary threat to spotted owl habitat. Management recommendations are outlined in the recovery plan in appendix C (pp 249 – 298) to guide land managers with reducing the fire risk within the PACs and recovery habitat.

Protected activity centers (PACs)

All activities within the PAC should undergo consultation with the appropriate FWS office

No mechanical or prescribed fire during the breeding season

Removal of hardwoods, downed woody debris, snags, and other key habitat variables should occur only when compatible with owl habitat management objectives as documented through reasoned analysis

Light burning of surface and low-lying fuels may be allowed following careful review by biologist and fuel-management specialist. Generally, burns should be done during non-breeding season.

Mechanical treatments may be needed to reduce fire risk to owl/nest roost habitat. As a general guide, forest management programs in PACs should be structured as follows:

Conduct a landscape-level fire risk assessment to strategically locate and prioritize mechanical treatment units to mitigate the risk of large wildland fires while minimizing impact to PACs. Treatments should also strive to mimic natural mosaic patterns.

No mechanical or prescribed fire treatments should occur during the breeding season unless the PAC is unoccupied.

Recovery Habitats

Manage a minimum of 10% of the pine-oak and 25% of the mixed conifer for nest/roost habitat.

Manage recovery habitat for all stages of ecological succession. Maintain a mosaic of successional stages across the landscape.

Assess existing conditions at multiple spatial scales.

Treatments within recovery habitat nest/roost stands which meet the minimum desired conditions outlined on Table C.3 on page 278 of the MSO Revised Recovery Plan will not lower the conditions below those thresholds.

It is recommended that trees larger than 18 inches dbh not be removed in nest/roost recovery stands.

Maintain species diversity and allow for variation in stand structures including early seral species.

Strive to retain all trees greater than 24 inches dbh. Remove only to protect human safety and or property, or in situations where leaving large trees precludes reducing threats to owl habitat.

To the extent practical treatments should be designed to avoid the removal of trees over 18 inches dbh.

In pine-oak forests, retain existing large oaks and promote growth of additional oaks.

Northern Goshawk

Elements that relate to northern goshawk forest habitat apply to the forest and woodland communities described below that are outside of Mexican spotted owl protected activity centers and recovery habitat areas:

Manage for uneven-age forest conditions for live trees and retain live reserve trees, snags, downed logs, and woody debris levels throughout woodland, ponderosa pine, mixed conifer, and spruce-fir forest cover types. Manage for old age trees such that as much old forest structure as possible is sustained over time across the landscape. Sustain a mosaic of vegetation densities (overstory and understory), age classes and species composition across the landscape.

Limit human activity in or near nest sites and Post-Fledging Family Areas (PFAs) during the breeding season (March 1 through September 30).

The distribution of vegetation structural stages for ponderosa pine, mixed conifer and spruce-fir is 10% grass/forb/shrub (VSS 1), 10% seedling-sapling (VSS 2), 20% young forest (VSS 3), 20% mid-aged forest (VSS 4), 20% mature forest (VSS 5), 20% old forest (VSS 6). Distribution of habitat structures should be evaluated at the ecosystem management area level, at the midscale such as drainage, and at the small scale of site.

Landscapes Outside Goshawk PFAs:

Ponderosa pine: canopy cover for mid-aged forest (VSS 4) should average 40+%, mature forest (VSS 5) should average 40+%, and old forest (VSS 6) should average 40+%. Maximum opening size is up to 4 acres with a maximum width of up to 200 feet. Retain 1 group of reserve trees per acre of 3-5 trees per group for openings greater than 1 acre in size. Leave at least 2 snags per acre, 3 large downed logs per acre, and 5-7 tons of woody debris per acre. Snags are 18 inches or larger dbh and 30 feet or larger in height, downed logs are 12 inches in diameter and at least 8 feet long, woody debris is 3 inches or larger on the forest floor, canopy cover is measured with vertical crown projection on average across the landscape.

Identify and manage dispersal PFA and nest habitat at 2 to 2.5 mile spacing across the landscape.

Within PFAs:

Ponderosa pine: canopy cover for mid-aged forest (VSS 4) should average 1/3 60+% and 2/3 50+%. Mature (VSS 5) and old forest (VSS 6) should average 50+%.

Within Nesting Areas:

Thin from below with non-uniform spacing. Lopping and scattering of thinning debris is preferred if prescribed fire cannot be used. Piling of debris should be limited.

Elements that relate to forest vegetation operations for old growth allocation:

Seek to develop or retain old growth function on at least 20% of the naturally forested area by forest type in any landscape.

All analyses should be at multiple scales-one scale above and one scale below the ecosystem management areas.

Soil & Water Resources

Implementation of a proposed amendment to the Forest Plan to allow mechanical treatments in MSO PACs beyond 9 inches dbh, treatments in MSO restricted habitat above 24 inches dbh, and treatments and prescribed burning within MSO nest/cores would result in improved vegetative ground cover over the long term by providing conditions conducive to the establishment of a more vigorous understory of grasses, forbs and shrubs. This increased vegetative ground cover would improve nutrient cycling and soil stability while reducing the risks to soils, water quality, and watershed function from the effects of a high severity fire. Proposed population and habitat monitoring would not pose a risk to soil, watershed function, and water quality.

Implementation of a proposed amendment to allow mechanical harvesting on slopes greater than 40 percent within the project area would facilitate thinning within the project area ultimately resulting in improved soil functioning and reducing the threat posed by a high severity fire to water quality, soil productivity and watershed function. Since the Forest Plan was written and amended, mechanized ground-based equipment has progressed to be able to operate on steep slopes without adverse impacts to soil resources.

Table 169: Soil & Water Resource Compliance with Forest Plan and Other Relevant Laws, Regulations, Policies and Plans

MANAGEMENT AREAS (MA)	DESCRIPTION	Standards and Guidelines	FLMP page
Forest-wide	Forest-wide	Use Best Management Practices to reduce nonpoint source pollution	Amendment 3, replacement page 71
Forest-wide	Forest-wide	Plan for appropriate filter strips adjacent to streamcourses and/or riparian areas	Amendment 3, replacement page 71
Forest-wide	Forest-wide	Designate streamcourses and riparian areas to receive protection during projects	Amendment 3, replacement page 72
Forest-wide	Forest-wide	Maintain current satisfactory watershed conditions and improve unsatisfactory conditions to satisfactory by the year 2020.	Page 74
Forest-wide	Forest-wide	Plan projects, parts of projects, and/or management practices for soil and water resources improvement where watershed condition is unsatisfactory. Incorporate plans for	Amendment 3, replacement page 72

MANAGEMENT AREAS (MA)	DESCRIPTION	Standards and Guidelines	FLMP page
		soil and water improvements into project planning for other resources	
3	Ponderosa Pine and Mixed Conifer less than 40% slopes	Identify each terrestrial ecosystem and assess soil properties to determine: Erosion hazard and on-site soil loss - Soils with a potential erosion hazard rating of severe will require specific resource management activities in order to avoid severe impairment of soil productivity.	Amendment 17, replacement page 120 Forest Plan p 146
3	Ponderosa Pine and Mixed Conifer less than 40% slopes	For each timber sale area, identify each terrestrial ecosystem and assess soil properties to determine: • Soils with severe potential for sheet and gully erosion, such as steep slopes, cinder cones, alluvial bottoms, and swales, that require specific resource management activities in order to avoid severe impairment of soil productivity. • Soil limitations for site preparation - Identify soils that present severe limitations for successful site preparation such as soils with severe erosion hazard and shallow soils. Require specific resource management activities where successful site preparation is limited by environmental factors in the terrestrial ecosystem. • Soil potential for reforestation - Identify soils that are suitable or unsuitable for successful reforestation. Adjust stocking levels and require specific resource management activities where successful reforestation is limited by environmental factors in the terrestrial ecosystem. • Whether soils are suitable, unsuitable, or unproductive for timber management. • Soil limitations for timber harvest activities. • Soils with high potential to convert to another vegetative type such as oak, locust, or juniper as a result of timber management activities - Modify timber management activities in these terrestrial	Amendment 1, replacement page 136

MANAGEMENT AREAS (MA)	DESCRIPTION	Standards and Guidelines	FLMP page
		ecosystems conversion by approved chemical or mechanical means or by prescribed fire.	
3	Ponderosa Pine and Mixed Conifer less than 40% slopes	Where open meadows in the pine/mixed conifer type are to be maintained, eliminate invading overstory vegetation, stabilize gullies to raise the water table, scarify the soil, and seed with appropriate grass and forage species. Control livestock grazing through management and/or fencing to establish the revegetation.	Amendment 17, replacement page 120
3	Ponderosa Pine and Mixed Conifer less than 40% slopes	Avoid or designate stream course crossings for skid trails. Limit to the minimum needed. Choose crossings with stable conditions or stable bed and bank material such as cobble or rock.	Amendment 1, replacement page 136
3	Ponderosa Pine and Mixed Conifer less than 40% slopes	Restrict skidding and hauling to soil moisture conditions that do not cause excessive soil compaction, displacement, or puddling.	Amendment 1, replacement page 136
9	Mountain Grassland	Manage mountain grasslands to achieve 90 percent of potential ground cover to prevent accelerated surface erosion and gully formation. Areas that presently do not meet these standards are scarified and seeded to bring ground cover to the desired level by the second decade. Restricting livestock may be necessary until revegetation.	Forest Plan, P 160
9	Mountain Grassland	Identify each terrestrial ecosystem and assess soil properties to determine: Soil potential for revegetation - Identify soils that are suitable or unsuitable for successful revegetation, erosion hazard, and on-site soil loss. Soils with a potential erosion hazard rating of severe will require specific resource management activities in order to avoid severe impairment of soil productivity.	Forest Plan, P 160

Wildlife

Regulatory Framework

The Forest Service is legally required to comply with a number of federal regulatory requirements associated with various sections of the Endangered Species Act of 1973, as amended (ESA); the Bald and Golden Eagle Protection Act of 1940, as amended; Forest Service Manuals (FSM) 2620, 2630, 2670, and 2672; Migratory Bird Treaty Act of 1918 (as amended); Executive Order 13186 (migratory birds), National Environmental Policy Act, 1969; National Forest Management Act, 1976 (as amended); and the Coconino National Forest Land and Resource Management Plan (Forest Plan), 1987 (as amended).

The Endangered Species Act (ESA)

The Endangered Species Act (ESA) of 1973, as amended, provides that all Federal agencies utilize their authorities to carry out programs for the conservation of listed species. It prohibits any Federal agency from carrying out any action that is likely to jeopardize the continued existence of any listed species. It further requires federal agencies to consult with the Fish and Wildlife Service (FWS) on actions that are authorized, funded, or carried out by such agencies that may affect listed species and/or their designated critical habitat. The ESA mandates conference with the Secretary of the Interior whenever an action is likely to jeopardize the continued existence of any species proposed for listing as threatened or endangered, or whenever an action might result in destruction or adverse modification of critical habitat proposed for listing.

Bald and Golden Eagle Protection Act (Eagle Act)

The Eagle Act, originally passed in 1940, prohibits the take, possession, sale, purchase, barter, offer to sell, purchase, or barter, transport, export, or import, of any bald or golden eagle, alive or dead, including any part, nest, or egg, unless allowed by permit (16U.S.C 668(a);50CFR 22). "Take" is defined as to "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest, or disturb" a bald or golden eagle. The term "disturb" under the Eagle Act was defined via a final rule published in the Federal Register on June 5, 2007 (72 Fed. Reg.31332). "Disturb" means to agitate or bother a bald or golden eagle to a degree that causes, or is likely to cause, based on the best scientific information available: 1) injury to an eagle; 2) a decrease in its productivity, by substantially interfering with normal breeding, feeding, or sheltering behavior; or 3) nest abandonment, by substantially interfering with normal breeding, feeding, or sheltering behavior. The Fish and Wildlife Service recommends using the *Conservation Assessment and Strategy for Bald Eagles in Arizona* (Driscoll et al. 2006) in conjunction with the *Bald Eagle National Management Guidelines* (USFS 2007) to protect bald eagles in Arizona.

Forest Service (FS) Sensitive Species

Sensitive species are defined as "those plant and animal species identified by a Regional Forester for which population viability is a concern, as evidenced by: 1) significant current or predicted downward trends in population numbers or density, or 2) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution (FSM 2670.5(19)). It is the policy of the Forest Service regarding sensitive species to 1) assist states in achieving their goals for conservation of endemic species, 2) as part of the National Environmental Policy Act process, review programs and activities, through a biological evaluation, to determine their potential effect on sensitive species, 3) avoid or minimize impacts to species whose viability has been identified as a concern, 4) if impacts cannot be avoided, analyze the significance of potential adverse effects on the population or its habitat within the area of concern and on the species as a whole (the Line Officer, with project approval authority, makes the decision to allow or disallow impacts, but the decision must not result in loss of species viability or create significant trends toward federal listing), and 5) establish management objectives in cooperation with the state when projects on National Forest system lands may have a significant effect on sensitive species population numbers or distributions. Establish objectives for federal candidate species, in cooperation with the U.S. Fish and Wildlife Service and Arizona State (FSM 2670.32).

Management Indicator Species (MIS)

A working draft forest-wide assessment entitled "Management Indicator Species Status Report for the Coconino National Forest" (USDA 2013) summarizes current knowledge of population and habitat trends for management indicator species on the Coconino National Forest. Additional site specific Game Management Unit (GMU) population information was provided by Arizona Game and Fish Department with their annual survey results.

Migratory Bird Treaty Act

Executive Order 13186 (January 10, 2001) requires federal agencies to consider management impacts to migratory birds. Birds considered for these analyses were selected from species of concern as listed by Partners in Flight (Latta, et al. 1999) and the USFWS Birds of Conservation Concern (USFWS 2009) and the determination of possible impacts that would occur if any one of the alternatives were implemented is disclosed.

Coconino National Forest Land Management Plan (Forest Plan)

The Forest Plan determines standards and guidelines for snags and downed logs, wildlife cover, raptor nest buffers, old growth, turkey nesting and roosting habitat, and bear habitat. It also incorporates the 1996 Mexican Spotted Owl Recovery Plan and Northern Goshawk Management Recommendations. Two project-specific amendments to the Coconino National Forest Land Management Plan are proposed for each action alternative. The first amendment would ensure the treatments proposed in MSO habitat align with the 2012 MSO Recovery Plan and would also remove timing restrictions within MSO PACs for the duration of the FWPP project. The second allows for mechanized harvest on slopes greater than 40 percent within the project area (see Appendix A for Forest Plan amendment descriptions).

Scenery

Policy

Forest Service Handbook (FSH) 1909.13.13a, Chapter 10: "When pertinent to the issues…the Scenery Management System (SMS) should be used to describe…desired conditions and objectives."

FSH 1909.13.2.3: "…"Also, see FSM 2380.61 for landscape aesthetics guidance."

Forest Service Manual (FSM) 2380.43.5 "Ensure application of the principles of landscape aesthetics, scenery management, and environmental design in project level planning"

FSM 2380.61 "Refer to the following publications in the Department of Agriculture's National Forest Landscape Management Series for technical guidance in managing landscape aesthetics and scenery." The pertinent publication is USDA Ag Handbook 701, "Landscape Aesthetics: A Handbook for Scenery Management". This Handbook directs identification of Desired Scenic Character (page 1-3 and 5-5), as does its most recent update "Appendix J Recommended SMS Refinements" 2007, and the "Region 5 SMS Implementation Process" 5/2009.

FSM 2020.5 "Sustainability. Meeting needs of the present generation without compromising the ability of future generations to meet their needs. Sustainability is composed of desirable social, economic, and ecological conditions or trends interacting at varying spatial and temporal scales, embodying the principles of multiple-use and sustained-yield (FSM 1905)."

The following USDA handbooks establish a framework for management of scenic resources. These handbooks were written when the visual management system (VMS) was in place. Although the VMS has now been replaced by the scenery management system, the handbooks still apply to management of scenic resources.

National Forest Landscape Management Volume 1. Agriculture Handbook 434: 1973

Roads, Chapter 4, Agriculture Handbook 483: 1977

Timber, Chapter 5, Agriculture Handbook 559: 1980

Fire, Chapter 6, Agriculture Handbook 608: 1985

Recreation, Chapter 8, Agriculture Handbook 666: 1987

Landscape Aesthetics, A Handbook for Scenery Management, Agriculture Handbook 701: revised 2000.

Forest Service manual direction provides further clarification to utilize the Scenery Management System in forest and project planning and implementation, including sections 2380.3, 2382, and 2382.3:

2380.3, Policy: It is Forest Service policy to:

Inventory, evaluate, manage, and, where necessary, restore scenery as a fully integrated part of the ecosystems of National Forest System lands and of the land and resource management and planning process.

Employ a systematic, interdisciplinary approach to scenery management to ensure the integrated use of the natural and social sciences and environmental design.

Ensure scenery is treated equally with other resources.

Apply scenery management principles routinely in all National Forest System activities.

2382, Scenery Management: Managing scenery on National Forest System lands entails:

1. Completing and maintaining an inventory of landscape aesthetics and scenery resources. Establishing goals and objectives for the management of scenery on all National Forest System lands.

2382.3 - Forest Plan Revisions and Scenery Management System

Update the scenery inventory using the Scenery Management System in Agriculture Handbook 701 (FSM 2380.61, para. 2). The recommended timeframe for updating the scenery inventory is prior to or at initiation of Forest land and resource management plan revisions.

The table below summarizes the existing Forest Management Plan direction. It is followed by the proposed Revised Forest Management Plan direction

Table 170: Summary of the existing Forest Plan management direction for scenery (Forest Service 1987)

DESCRIPTION	Forest Plan Management Direction	FLMP page
Goals	Maintain and enhance visual resource values by including visual quality objectives in resource planning and management activities.	Replacement p.22
Forest-wide	Projects are planned to meet or exceed visual quality objectives (VQO). Review the VQO inventory as a part of project planning and make necessary corrections/refinements following field checking. Use VQO inventory to analyze impacts to VQO classes due to management activities such as timber sales, range projects, and firewood sales. Use the current Forest Visual Resource Management Inventory that lists VQO Forest-wide in conjunction with Forest Plan MA Map and descriptions to plan projects. Allow only one classification movement downward unless a larger movement is justified after doing an environmental analysis for emergency situations such as removal of fire damaged timber or I&DC control needs.	Replacement p.60
Forest-wide	…design timber management activities to integrate considerations for economics, water quality, soils, wildlife habitat, recreation opportunities, visual quality, and other values.	Replacement p.23
Ponderosa Pine and Mixed Conifer less than 40% slopes	Stand size, except managed old-growth stands, foreground Retention areas, or stands resulting from catastrophic events, such as wildfires or epidemic insect infestation, is between 10 and 100 acres unless larger or smaller stands are approved by the Forest Supervisor. Exceptions are stands managed for conversion to aspen and those managed as Gambel Oak nonindustrial wood, which can be as small as 5 acres and 1 acre, respectively and have maximum sizes of 10 and 40 acres, respectively. Also stands having a VQO of foreground Retention can be 2.5 acres. Stands are defined in the environmental documentation (ISM Phase IX) and documented in the timber sale project plan (ISM Phase X). Silvicultural treatments are designed to improve age class distribution within a 10K Block. The goal is to attain differences between adjacent timber stands by the time the first regeneration period is completed, which is	Replacement Pg. 129

DESCRIPTION	Forest Plan Management Direction	FLMP page
	when the seed trees are removed and the regenerated stand is certified, unless there is a specific management need, approved by the Forest Supervisor that delays achieving the goal. Progress towards the goal is made during each commercial entry. Manage to achieve, where possible, not more than one-quarter of a stand's perimeter in common with an adjacent stand whose characteristics do not meet minimums factors.	
Ponderosa Pine and Mixed Conifer less than 40% slopes	Timber stands managed to meet visual management objective (VQO) of foreground retention are managed as follows: Maintain or create a mosaic of stands of various sizes and age classes throughout the rotation. Obtain a stand of ponderosa pine and/or mixed conifer at maturity of 30 to 45 trees per acre. The average diameter of mature trees is 20 inches or greater. The large trees are maintained as long as possible. Extended rotations may be necessary. Allow naturally regenerated trees to stay if the overall visual quality objective is met. Obtain diversity of landscape management features. Created slash is promptly treated. Mistletoe treatments are designed to meet as many of these Standards as possible. Precommercial thinning is done as needed to meet the visual quality objectives.	Page 133
Ponderosa Pine and Mixed Conifer less than 40% slopes	Silvicultural Prescription in Foreground Retention Areas: *Uneven-Aged Management* – Uneven-aged stands have three or more distinct age classes present. The different aged trees are usually intermixed. Cutting methods are used that develop and maintain uneven-aged stands such as single-tree selection and group selection. Stands are entered on a 20-year cutting cycle and cut to a GSL of 100. Stand size is determined by the scale of the landscape, width of the road, and the speed of the viewer (e.g., I-17 vs. 89A). Stand size	Pg.133

DESCRIPTION	Forest Plan Management Direction	FLMP page
	may be less than 10 acres.	
Ponderosa Pine and Mixed Conifer less than 40% slopes	*Deferred Management* Deferred harvest management is used on stands that presently meet foreground Retention stand characteristics. These stands are managed by the uneven-aged management prescription when the stands no longer meet foreground Retention stand characteristics. Roads to be managed for foreground Retention within this MA and in MA 4 (other areas of foreground retention on the timber type are found in MA's 13 and 19): Road Miles (*only those in the treatment area are noted here)*Arizona Hwy 87 – 29, FH 3 - 46 An average 300 feet on each side of the road will be managed as foreground Retention (nearly 20,000 acres) total from all MA's. Determine the exact width of the foreground Retention area after on-the-ground review. **Foreground Partial Retention (VQO) Silvicultural Objectives are:** To maintain or create a mosaic of stands of various sizes and age classes throughout the rotation with a mature tree component (+18 inches d.b.h.) on at least 10 percent of the area. **Created slash will be treated.**	Pg.134
Unproductive Timber Land -	Visual Quality Objectives (VQO) are managed in accordance with the Forest-wide Standards and Guidelines	Pg.145
FLEA Area-Wide Goals and Objectives **FLEA Area-Wide Guidelines**	There is a range of recreational setting opportunities for people to enjoy the area’s many scenic and aesthetic qualities. Work towards a complete Scenery Management System (SMS) assessment. Provide fast clean-up from management activities and limit short-term visual impacts (1 to 3 years), while meeting fire potential reduction needs, design thinning for long-term scenic quality adjacent to homes and along major highways or near developed recreation sites.	Replacement Pg.206-62 Replacement Pg.206-70

The Coconino NF is in the process of revising its forest management plan. A review of the current draft (Forest Service 2013) includes the following information:

Ponderosa Pine Desired Conditions	**At landscape scale:** **1.** Ponderosa Pine has a mosaic of trees with varying age classes and understory vegetation which provide habitat for a variety of species, including Mexican spotted owls and northern goshawks, and ground fuels conducive to low-severity fires. **2.** The composition, structure, and function of vegetation conditions are resilient to the frequency, extent, and severity of disturbances and climate variability that is similar to conditions prior to 1850 (pre-fire disruption[17]). The landscape is a functioning ecosystem that contains its components, processes, and conditions that result from endemic levels of disturbances (e.g. insects, diseases, fire, and wind), including snags, downed logs, and old trees. Grasses, forbs, shrubs, and needle cast (e.g., fine fuels), and small trees maintain the natural fire regime. Organic ground cover and herbaceous vegetation provide **3** Frequent, low-severity fires (Fire Regime I) are characteristic in this PNVT, including throughout northern goshawk home ranges. Spatial heterogeneity and discontinuous crowns (interspaces between groups and single trees) prevents fire spread. Natural and human disturbances are sufficient to maintain desired overall tree density, structure, species composition, coarse woody debris, and nutrient cycling. **4.** At the landscape scale and as shown in table 9, Ponderosa Pine is composed of trees in structural stages that range from young to old and are dominated by ponderosa pine trees. Forest appearance is variable but generally uneven-aged and open; occasional areas of even-aged structure are present. Forest arrangement is in individual trees, small clumps, and groups of trees interspersed within variably sized openings of grasses, forbs, and shrubs that are similar to historic patterns. Openings typically range from 10 percent in more productive sites to 70 percent in the less productive sites. The size and shape of trees, number of trees per group, and number of groups per area are variable across the landscape. Denser tree conditions exist in some locations such as north-facing slopes and canyon bottoms. protection of soil, moisture infiltration, and contribute to plant and animal diversity and to ecosystem function. 5. Ponderosa Pine is composed predominantly of vigorous trees, but declining trees are a component. Declining trees are well distributed across the landscape and may occur as clumps or individual trees. They provide for snags, top-killed, lightning-scarred and fire-scarred trees, and coarse woody debris (greater than 3-inch diameter, including large logs). 6. Old growth structure occurs throughout the landscape, generally in small areas as individual old-growth components, or as clumps of old growth. Consistent with vegetative characteristics of a frequent, low severity fire regime, old growth is a component of uneven-aged forests, generally comprised of groups of similarly aged trees and single trees interspersed with open grass–forb–shrub interspaces, but occasionally, it occurs in larger even-aged patches where local microsites facilitate less frequent fire regimes. Within group variability may be low but variation among groups is typically high and proportions of patches with different developmental stages may vary depending on site-specific conditions. Old growth components include old trees, dead trees (snags), and dead and downed wood (coarse woody debris including large size classes). Snags and large dead and downed fuels are irregularly distributed across the landscape and may not exist in some patches. The location of old growth components shifts on the landscape over time as a result of succession and disturbance (tree growth and mortality).	Pg. 52-54

Desired Conditions for Scenic Resources	**1.** The scenic values of the Coconino NF are conserved and enhanced. Visitors see that the forest is being actively managed through visual cues such as seeing firebreaks with native wildflowers, grasses, and forbs; some fire effects; and tree thinning to frame views from trails and developed recreation sites. **2.** Vegetation treatments contribute to the scenic integrity of the desired landscape character (see chapter 3, "Management Areas"), especially in highly sensitive areas. Management-created debris, such as slash along Concern Level 1 and 2 travel routes, are located and arranged to minimize their visual disturbance in the immediate foreground (up to 300 feet), and slash piles in that immediate foreground are not evident once they are burned or scattered. Openings and stand boundaries are naturally shaped and are oriented to contours and existing vegetation patterns to blend with existing landscape characteristics, except where other natural resource concerns require minimal treatment along powerline corridors. **5.** Long term soil and plant productivity, proper functioning ecosystems, and clean water are considered important components of scenic quality. Rock pits, borrow areas, open pit mines, and restored gullies have very low scenic integrity and are not seen from visually sensitive travelways and viewing points to the extent possible. Cultural and historic features, young cinder cones, and lava flows are recognized for their inherent scenic values. Native plant rehabilitation is carried out in disturbed areas to speed scenic quality recovery. Natural land forms and vegetation are used, to the extent possible, to screen facilities from important viewing locations such as scenic trails and byways.	Pg. 113-114
Objectives for Scenic Resources	**1.** Rehabilitate at least 25,000 acres that do not meet the desired scenic integrity objective (SIO) by at least one level within 15 years of plan approval.	Pg. 114

Guidelines for Scenic Resources	**1.** To maintain SIOs, management activities that are inconsistent with the SIO and whose effects persist in the long term should not occur unless a decision is made to change the SIO[44]. Site-specific exceptions can be made based on lower site productivity, soil conditions, and climate without changing the SIO. Additional design features may be needed in these cases. **2.** To maintain consistency with the Scenery Management System in the long-term: • Deviations[45] in areas with high SIO should not be evident even if they are present. • Deviations in areas with moderate SIO should be allowed but remain visually subordinate to the landscape being viewed. • Deviations in areas with low SIO should borrow valued attributes from the landscape being viewed, even though the deviations may begin to dominate the views. **4.** Visually attractive live and dead trees, some large woody debris, and understory shrubs <u>foreground</u> (half a mile or less) should be favored when leaving vegetation in the of Concern Level 1 and 2 travel routes in order to enhance the desired landscape character. **5** Stems should be flush cut, if possible, or cut less than 6 inches above ground (uphill side) in the immediate foreground (300 feet or less) of Concern Level 1 and 2 travel routes where topography and operational safety allows in order to minimize the scenic impact of management activities. **6.** When possible, new log landings, roads, and designated skid trails should be located out of view of Concern Level 1 and 2 travel routes to avoid observation of bare mineral soil. When avoiding these locations is not possible, the evidence of these activities should be restored following completion of the activity to harmonize with the surrounding landscape. **7.** To minimize disruption of the visual landscape, straight lines and geometric shapes should be avoided at the edges of openings and stand boundaries. **8.** Evidence of fire activities should be dominant for no more than 3 years after burning in areas of high scenic integrity and 5 years in moderate scenic integrity in order to maintain SIOs.	Pg. 114

Desired Conditions for Pine Belt Management Area Scenery – Desired Landscape Character	**1.** The Pine Belt MA itself is flat to gently sloping with scattered, steeper landforms including Mormon Mountain, lands around Kendrick Peak, the West Clear Creek drainage, Walnut Canyon, Pumphouse Wash, Fry Canyon, Saddle Mountain, a number of prominent hills and mountains in the northern portion of the management area and various escarpments throughout. On the northern end, evidence of volcanic geology is more common. **2.** This area is valued for its continuous stands of uneven-aged ponderosa pine, old-growth “yellow-belly” ponderosa pine stands, and beautiful lakes for boating and fishing. This management area is comprised of Ponderosa Pine and Piñon-Juniper Woodlands vegetation types which cluster around broad expanses of grassy openings and picturesque lakes. Ponderosa pine is all-aged and includes large trees with open, well-formed crowns. The forest is generally open and park like with a diverse understory of grasses and shrubs. Tree conditions in places such as north-facing slopes and canyon bottoms are sometimes more dense. The distribution and class of trees across the landscape corresponds with the ecological desired conditions for this vegetation type. Old growth ponderosa pines as groups or as individual specimens provide a valued landscape feature that adds to the sense of diversity and discovery in this zone. Snags, top-killed trees, down logs, and other evidence of fire and wind disturbance occur individually and in patches of varying sizes. They provide an intriguing feature whose distribution on the landscape varies over time. Standing dead trees provide character and wildlife habitat and some are retained (see the desired conditions for the ponderosa pine vegetation type for more information). **4.** Gambel oak and aspen provide a desirable visual contrast to the evergreen pine in fall. In winter, this management area provides recreationists a white, snow-covered landscape that contrasts with evergreen trees. In the summer, it provides cool shady areas for a variety of recreation activities. Arizona walnut trees in Walnut Canyon provide a valued scenic feature in this management area that contributes an interesting bark and texture against the winter sky and yellow fall color.	Pg. 119-120

San Francisco Peaks Management Area Scenery – Desired Landscape Character (also apply to Fort Valley/Mount Elden MA and Pine Belt MA)	**2.** Vegetation varies along the elevation gradient from open ponderosa pine stands with views of the surrounding landscape to sun-dappled shade of Spruce-Fir and Mixed Conifer to rocky and sparsely vegetated alpine communities. Within these vegetation types, steep, cool drainages, and fire disturbance create microclimates with a surprising diversity of landscape features such as high elevation mountain meadows, communities of bristlecone pine, and aspen that contrast with dark evergreen surroundings. Aspen and grasslands, in particular, create openings that provide a sense of the surrounding landscape. The lower slopes of this MA gradually flatten and blend into the surrounding plateau.	Pg. 121
Flagstaff Neighborwoods Management Area Scenery	**1.** Natural landscape is highly valued by local residents and visitors. National Forest System lands provide the backdrop for the community's character while accommodating features that are more typical of an urban or rural setting. Infrastructure and developments that serve a broad public interest are sometimes evident but still subordinate to the landscape. Recreation developments contribute to the area's unique sense of place through use of native materials; mimicking line, form, color, and texture of the surrounding landscape; or use of identifiable Forest Service symbols and historic features.	Pg. 123

Socio-Economics

The land and resource management plan for the Coconino National Forest (the Forest Plan) does not specify desired conditions and strategies specific to the social and economic environment. However, the Forest Plan does incorporate strategic direction related to air quality, transportation, forest products, wildland fire management, and other resource areas that are relevant to the social and economic environment. The following consistency analysis draws on those sections that are linked to proposed management actions under FWPP.

Coconino National Forest Plan

The following desired conditions and guidelines from the Coconino NF plan (1987, as amended) are relevant to FWPP:

- "Provide and manage a serviceable road transportation system that meets needs for public access, land management, resource protection, and user safety" (pg. 24).
- "Manage smoke from prescribed fires to meet legal standards and to provide for public safety" (pg. 92).

FWPP would not result in any changes to the public road network within the project area. Implementation of FWPP would decommission 4.38 miles of existing roads (across the two areas). The transportation analysis discusses the transportation system related to each alternative.

Environmental Justice

Executive Order 12898

Executive Order 12898 provides that, “each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations.” This analysis was performed (see Chapter 3) and no disproportionately high and adverse human health or environmental effects are anticipated as a result of any of the alternatives.

Invasive Plant Species

Below is a partial list of federal and state laws, executive orders, and Forest direction pertaining to project-specific planning and environmental analysis for this project as they relate to invasive plant species.

- Coconino National Forest Land and Resource Management Plan, 1987 (as amended).
- Resource Planning Act, 1974 (as amended). This act directs the National Forest Service to inventory, protect and address the effects to natural resources.
- Multiple-Use Sustained-Yield Act of 1960. This act designates multiple uses with equal standing in the National Forests. These include recreation, range, timber, watershed, wildlife and fish. It introduces the principles of multiple use and sustained yield on the National Forests.
- National Environmental Policy Act, 1969. This act requires all federal agencies to analyze the effects of management actions and prepare Environmental Assessments or Environmental Impact Statements to address these impacts (depending on the complexity of the project).
- National Forest Management Act, 1976 (as amended); 36 CFR 219. The NFMA Act originated as an amendment to the Resources Planning Act (1974) to address legal challenges. It provided direction requiring an interdisciplinary and systematic approach to resource management and provided for public input on preparing and revising forest plans.
- Executive Order 13112 of 1999, regarding noxious weed or invasive plant species control. This executive order is one of the founding directives of the noxious or invasive weed control on National Forest system lands.
- Forest Service Manuals 2900 and 2150 and Regional Supplement No. 2100-98-1, regarding noxious weed control.
- Noxious Weeds Strategic Plan Working Guidelines– Coconino, Kaibab, and Prescott National Forests (1998). These working guidelines were developed by the three forests to manage noxious or invasive weeds. Noxious weed invasions were recognized as an emerging issue and growing problem.

- Arizona State regulations R3-4-244, R3-4-245 require that the landowner must have an active management program to prevent further spread of weeds and reduce numbers of existing populations.
- Final Environmental Impact Statement for the Integrated Treatment of Noxious or Invasive Weeds, Coconino, Kaibab and Prescott National Forests within Coconino, Gila, Mojave and Yavapai Counties, Arizona (USFS, 2005), incorporated into the Forest Plan by Plan Amendment 20 (2005).

Recreation

Current management direction for recreation resources on the Coconino National Forest can be found in the following documents on file at the Coconino National Forest's District offices:

1987 USDA Forest Service Coconino National Forest Land and Resource Management Plan (Forest Plan) and all subsequent amendments (USDA, 1987).

36 CFR Part 294 Special Areas

FSM 2300 – Recreation, Wilderness and Related Resource Management

Recreation Opportunity Spectrum (ROS) Users Guide

The table below summarizes the existing Forest Plan direction.

Table 171: Summary of the existing Forest Plan management direction for Recreation and Wilderness (Forest Service, 1987)

DESCRIPTION	Forest Plan Management Direction	page(s)
Goals	Manage the recreation resource to increase opportunities for a wide variety of developed and dispersed experiences (Recreation). Maintain and variety of Forest trails that include foot, horse, bicycle, and motorized trails, and challenge and adventure opportunities, as well as opportunities for the handicapped (Recreation). Manage off-road driving to provide opportunities while protecting resources and minimizing conflicts with other users (Recreation). Provide a wilderness management program that achieves high quality wilderness values while providing for quality wilderness recreation experiences (Wilderness). Provide an area for environmental educational opportunities for the public school system, youth organizations, and the general public by maintaining the ecosystem and developing interpretive facilities (Elden Environmental Study Area).	22, 25

DESCRIPTION	Forest Plan Management Direction	page(s)
Forest-wide	Issue and administer dispersed recreation special-use authorizations to provide needed recreation opportunities, minimize user conflicts, and ensure public safety and resource protection (Recreation). Review the ROS inventory as part of the project planning and make necessary corrections/refinements following field checking. Use the ROS inventory to analyze impacts to ROS classes due to management activities such as timber sales, range projects, and firewood sales (Recreation). Dispersed recreation areas are managed at standard service level (Recreation). Manage areas for public safety, resource protection, compliance checks, and capacity monitoring (Recreation). Wildernesses are managed to maintain wilderness quality and to maintain use within capacity. Manage to provide a quality experience for people while protecting wilderness resources (Wilderness).	51, 57, 105
MA 1 Wilderness	Enforce provisions of 36 CFR, part 261 and Title 16 U.S.C. regarding prohibitions in wilderness. Use the Limits of Acceptable Change (LAC) concept for establishing objectives, standards, and monitoring levels for wildernesses, as outlined in FS 2320.	106
MA 3 Ponderosa Pine and Mixed Conifer, less than 40 percent slopes	Manage dispersed recreation at the Standard Service Level. Manage the Mt. Elden/Dry Lake Hills to maintain a semi-primitive non-motorized ROS class.	119
MA 4 Ponderosa Pine and Mixed Conifer, greater than 40 percent slopes	Recreation use is concentrated on trails passing through the area because of the steepness and the amount of debris on the ground. In addition, some steep slopes are scenic backdrops for sensitive recreation viewpoints. Recreation use is largely limited to hiking and hunting. Manage with emphasis on wildlife habitat and dispersed recreation. Manage the Dry Lake Hills – Mt. Elden area for dispersed recreation and wildlife habitat and a semi-primitive non-motorized ROS class. Manage Mt. Elden/Dry Lake Hills for visual quality objective of	138, 139, 140

DESCRIPTION	Forest Plan Management Direction	page(s)
	Retention.	
MA 18 Elden Environmental Study Area	Emphasize environmental education opportunities for the Flagstaff Public Schools and the general public by maintaining the ecosystem and developing interpretive facilities. Non-motorized dispersed recreation is encouraged. Plan and support uses and trail in conjunction with the curriculum needs of the Flagstaff Public Schools.	197, 198
FLEA Amendment 17 Area-Wide Goals and Objectives for ROS	There is a range of recreational setting opportunities for people to enjoy the area's many scenic and aesthetic qualities. The diversity and quality of recreation opportunities, settings, and experiences are within acceptable limits of change to ecosystem stability and condition. Evidence of human activities and developments such as roads, trails, and facilities, is visually subordinate to the natural-appearing landscape.	206-62
FLEA Amendment 17 Area-Wide Goals and Objectives for Camping	Dispersed campsites are maintained to protect forest resources and maintain visitor experience.	206-63
FLEA Amendment 17 Area-Wide Goals and Objectives for Rock Climbing	Rock climbing areas are managed and maintained for appropriate experience, natural settings, attributes, and conditions, considering ROS objectives, wildlife, heritage, and soil and water resources. Rock climbing areas are managed in partnership with local rock climbers, climbing organizations, and outdoor recreationists.	206-66
FLEA Amendment 17 Area-Wide Goals and Objectives for Non-Motorized Trails	There are opportunities for a variety of trail experiences and challenges that are consistent with protection of sensitive resources, meet the needs of a diverse public, emphasize the natural environment, and meet ROS objectives. There is a network of trails linked to other trail systems, such as City and County trail systems. Trailheads are located in popular areas and provide adequate	206-67, 206-68

DESCRIPTION	Forest Plan Management Direction	page(s)
	parking, signs, restroom facilities, public education, and resource management.	

Heritage

Federal Laws

Protection and management of heritage resource on National Forest System land is mandated by the 1966 National Historic Preservation Act, as amended (NHPA), 36 CFR 800, and Forest Service Manual 2360, American Indian Religious Freedom Act, Archaeological Resource Protection Act and the National Environmental Policy Act (NEPA).

Programmatic Agreement

In addition, the Southwest Region has developed alternative procedures, per 36 CFR 800.14, in the form of the Region 3 First Amended Programmatic Agreement Regarding Historic Property Protection and Responsibilities. An appendix to this Agreement, *APPENDIX J STANDARD CONSULTATION PROTOCOL FOR LARGE-SCALE FUELS REDUCTION, VEGETATION TREATMENT, AND HABITAT IMPROVEMENT PROJECTS* establishes standard procedures for NHPA compliance for fuels reduction related undertakings.

Coconino Forest Plan

The 1987 Coconino National Forest Land Management Plan as amended provides general direction for the management of historic and cultural resources significant to our national heritage. The plan provides direction for forest-wide management of cultural resources. General management direction for cultural resources is outlined below:

The forest-wide standards and guidelines pertinent to this analysis are detailed in FLMP pp. 53-54; Amendment 1, p. 50; Amendment 9, pp. 52-3 to 52-4; and the FSM, Section 2360. These are summarized below:

Forest Plan (1987)

Project undertakings are inventoried for cultural resources and areas of Native American traditional use. Inventory intensity complies with Regional policy, and the settlement agreement in the Save the Jemez Lawsuit, and is determined in consultation with the State Historic Preservation Officer (SHPO). Generally, inventory standards are:

One hundred percent survey of all projects causing surface disturbance;

When less than 100 percent survey is deemed appropriate, the proportion of survey is generally greater than 10 percent and is determined in consultation with the State Historic Preservation Officer. Factors determining the appropriate inventory sample include the nature and extent of project impact, site density, site type, and ground cover;

Consultation with appropriate Native American groups;

Consultation with the SHPO, and if necessary, the Advisory Council on Historic Preservation (ACHP) before project implementation.

Gaps: None

Management strives to achieve a “No Effect” determination. Sites not evaluated are managed as ‘Eligible” and avoided by all projects and undertakings.

Gaps: In the case of the Flagstaff Watershed Protection Project, a determination of “No Adverse Effect” will be used to allow the use of prescribed fire across sites. This change in determination of effects is recommended in the next Forest Plan Revision. No Adverse Effect is also appropriate when using sample heritage surveys to support environmental planning analysis, as the case with the FWPP project (see Haines and Peters 2013 for details about the sampling strategy).

In addition, although hand thinning within heritage sites is not explicitly in the current proposed action, such work is exempt from standard SHPO review and consultation by Appendix A (II) (Q) of the USFS Region 3 First Amended Programmatic Agreement and has no effect on historic properties. Therefore, if during the course of authorized activities, there is a need to thin within archeological sites, activities will take place according to Appendix J (II) of the USFS Region 3 First Amended Programmatic Agreement and will occur within site boundaries, provided *1) cutting is accomplished using hand tools only; 2) large diameter trees are felled away from all features; 3) materials removed from the site are done so by hand; and 4) there is no dragging of logs, trees, or thinned material across or within site boundaries. There will be no use of vehicles or other mechanized equipment within site boundaries, no staging of equipment within site boundaries, and no slash piles within site boundaries. An archaeologist may be required to monitor activities within sites and this will be at the discretion of the District Archaeologist.*

Within project areas, site condition is monitored during and after project implementation.

Gaps: None

Sites listed on the National Register of Historic Places are visited at least biannually.

Gaps: Limited by workloads and funding constraints

Cultural resource sites are interpreted through lectures, tours, papers, reports, publications, brochures, displays, films, trails, signs, and other means.

Gaps: Limited by funding constraints

Survey priorities are to: 1) Provide clearance for projects; 2) Fill in gaps in existing inventory coverage; 3) Survey areas of known high site density; and 4) Survey areas that would do the most to answer current archaeological questions.

Gaps: Limited by funding constraints

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